JAN 18 1943

ENGINEERING NEWS-RECORD

JANUARY 14, 1943

Highway Operations Under War Conditions

HOW TO MAINTAIN A NATIONAL HIGHWAY SYSTEM ADEQUATE FOR THE TRAFFIC LOAD PLACED ON IT BY THE NATION'S WAR ACTIVITIES

ALCAN HIGHWAY: Construction Tactics

War Roads in Michigan

Also in this issue:

MULTIPLE-ARCH CONCRETE ROOF SAVES STEEL

"UNSPINNING" THE TACOMA BRIDGE CABLES

HIGH-DEGREE TREATMENT OF CAMP SEWAGE

AIRPORT DRAINAGE ON A ROCKY SITE

It's Hard to Get Steel

BUT YOU CAN GET DRAINAGE

• America at war can afford no interruption of vital traffic. Proper drainage is doubly important now. Yet desirable as it is, steel must not be used in any drainage structure unless engineering integrity demands it. Even so, perhaps we can help you in other ways.

For example, ARMCO Emergency Pipe may be just the answer to your wartime drainage problems. This completely new design in wood pipe requires no steel sheets, bands, wire mesh or metal reinforcing. It is easy to handle and has ample strength to meet engineering standards. ARMCO Wood pipe is designed to last through the emergency. On more permanent installations, when replacement becomes necessary, a corrugated metal pipe may easily be threaded through or jacked around the wood structure.

Remember that ARMCO Corrugated Metal Pipe is only on temporary "leave of absence." It will be back with its flexible strength, ease of handling, tight joints, long lengths and low installation costs. Asbestos-Bonded Coatings and thick bituminous pavements will be back too—better than ever before—to guard against corrosion and erosion.

Meanwhile, can we assist with your drainage problems? The answer may be in the use of non-strategic materials, or in suggestions for repairing and salvaging older structures. Write to us for information. Armco Drainage Products Association, 15 Curtis St., Middletown, O.

ARMCO EMERGENCY PIPE

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Shipbuilding, Irrigation, Canals, Railroads

McGRAW-HILL PUBLISHING COMPANY, INC.

Publication Office: 99-129 North Broadway, Albany, N. Y. • Editorial and Executive Offices: 330 West 42nd Street, New York

JOHN ABBINK, *Publisher*

WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Manager*

Vol. 130 JANUARY 14, 1943 No. 2

COMING NEXT

• What are Flight Strips; what is their purpose; how are they designed; and how are they located and built? The answer to these questions will be found in *ENR* for Jan. 28 in a comprehensive article on PRA's ten million dollar Flight Strip program.

• What it takes to build 10,000-ton cargo vessels at the record rate of nearly 5½ ships per month will be told in the Jan. 28 issue. Here is a useful lesson in welding methods that deserves careful study by every member of the heavy construction industry. It is also a thought-provoking story of labor organized to function at top speed.

• Underground concrete fuel storage tanks as the Navy is building them—A study of the latest developments in prestressed concrete design to minimize shrinkage cracks. Construction procedure has reached a high degree of efficiency, and various types of linings to eliminate reactions between the fuel and the concrete have been developed.

ANNUAL REVIEW NUMBER

Activities of American engineers and constructors around the globe will be highlighted in a group of articles by outstanding authorities in the Annual Review Number of Feb. 11.

The Army's Corps of Engineers and the Navy's Seabees are extending their activities to every actual and potential battle front. Our Ferry Command is using airports across Africa built by Pan-American Airways. Sanitation developments in South America are brewing under the leadership of the Coordinator of Inter-American Affairs, and the open links in the highway from Texas to Panama are rapidly being closed. Each of these significant operations will be the subject of an article.

And, as in previous years, developments and prospects in the various fields of civil engineering and construction will be covered in articles by the editors. This, too, is the issue that contains the annual statistical review of construction and the photographic survey of outstanding accomplishments.

Index to Vol. 129, July-Dec. 1942 will appear in Jan. 28 issue.

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CHANGE OF ADDRESS

McGRAW-HILL PUBLISHING COMPANY
330 West 42d Street, New York, N. Y.

Director of Circulation:
Please change my address on Engineering News-Record

From .....

To .....

Signed .....

The factory above is the latest example of Ryerson Rigid-Frame Construction, Godin Tool and Die Company plant in Detroit — Cooper Construction Company, contracting engineers. The inset shows one of the many operations on reinforcing bars, a part of Ryerson Steel-Service.

Rigid-Frame Construction *Saves Steel* For the War Effort

Rigid-Frame (Reinforced Concrete) Uses Only a Fraction of the Steel Required in Ordinary Construction

Great economies in time, money and critical materials are a part of the latest Ryerson contribution to wartime ingenuity . . . an adaptation of *Rigid-Frame Construction* to a monitor type factory building. Note the absence of longitudinal roof beams and lintels. Even the cranes in these bays are supported by reinforced concrete beams.

Ryerson offers construction steels of all types from stock; also structural fabricating service. A special department for Contractors and Builders features a complete reinforcing steel-service. Every step from estimates to final delivery is coordinated with your needs. Experienced crews handle the cutting and forming to exact specifications. Deliveries are always scheduled with the progress of your work. Each shipment is tagged for quick assembly on the job.

When you contemplate new construction, let us work with you from the beginning. Ryerson may be able to help you save time and money.

WPB EXTENDS USE OF REINFORCING BARS

WPB Conservation Division, under Materials Substitution and Supply, now lists Reinforcing Bars as a Group II Material.

Ryerson Building Products

New billet or re-rolled rail deformed reinforcing rounds and squares conforming to Schedule I of Limitations Order L-211. Steel Spirals complete with channel spacers. Wire Mesh in rolls or sheets for building or road work.

Removable forms for concrete joist construction. Expansion and contraction joints, center strip, etc., for road work. Accessories for concrete reinforcing, safety guards, shelving, grilles, etc.; Ryex Standard expanded metal; Ryex flattened expanded metal; Ryex reinforcing expanded metal; and Ryex Walkway expanded metal.

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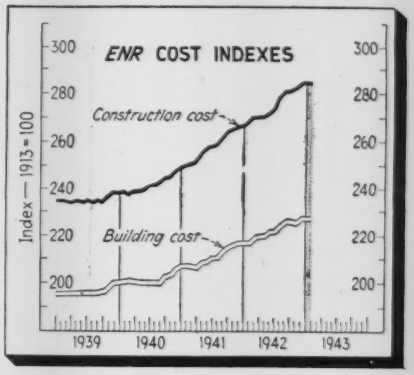
RYERSON REINFORCING STEEL-SERVICE

MONTHLY CONSTRUCTION BUSINESS SUMMARY

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	December 1941 (4 wk.)	December 1942 (5 wk.)	% Change*	Twelve Months 1941 (52 wk.)	Twelve Months 1942 (53 wk.)	% Change*
Total Construction	$269,689	$373,622	+11.0	$5,868,699	$9,305,829	+56.0
Private Construction	47,952	13,279	−78.0	1,178,082	555,823	−54.0
Public Construction	221,737	360,343	+30.0	4,690,617	8,750,006	+83.0
Federal	167,650	344,895	+65.0	3,500,488	8,241,088	+131.0
Total New Productive Capital	$1,612,832	$15,063	−99.0	$7,895,129	$10,219,318	+27.0
Private Investment	45,582	14,063	−75.0	798,020	399,977	−51.0
Federal (non-federal work)	4,000	1,000	−80.0	582,741	240,155	−59.5
Federal (federal work)	1,563,250	.....	.....	6,514,368	9,579,186	+44.0
FHA Mortgages Selected for Appraisal (Title II)	$64,230	$14,288	−78.0	$1,358,313	$511,405	−62.0
(Title VI)	18,996	28,656	+51.0	180,114	727,451	+304.0

* *Adjusted for difference in number of weeks.*



CONSTRUCTION COSTS . . . . . WAGE RATES . . . . . PRICES

	January 1942	January 1943	% Change	Changes December to January: Dec. 1941	Jan. 1942	%	Dec. 1942	Jan. 1943	%
E N R Construction Cost Index, 1913 = 100‡	267.63	283.45	+5.9	266.16	267.63	+0.6	283.69	283.45	−0.1
E N R Building Cost Index, 1913 = 100‡	217.12	226.87	+4.5	216.37	217.12	+0.3	226.63	226.87	+0.1

‡ *Does not reflect increased costs due to more overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$0.776	$0.832	+7.2	$0.769	$0.776	+0.9	$0.832	$0.832	0
Skilled Labor (Av. 3 trades)	1.531	1.606	+4.9	1.521	1.531	+0.7	1.599	1.606	+0.4
Bricklayers	1.626	1.700	+4.6	1.614	1.626	+0.7	1.693	1.700	+0.4
Structural Ironworkers	1.599	1.661	+3.9	1.588	1.599	+0.7	1.661	1.661	0
Carpenters	1.370	1.457	+6.4	1.362	1.370	+0.6	1.442	1.457	+1.0
Cement, per barrel	$2.60	$2.60	0	$2.56	$2.60	+1.6	$2.60	$2.60	0
Reinforcing steel, cwt	2.61	2.70	+3.4	2.59	2.61	+0.8	2.70	2.70	0
Struct. steel shapes, base	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.20	1.21	+0.8	1.19	1.20	+0.8	1.21	1.21	0
Lumber, 2x4 Fir, per M ft.	46.74	51.47	+10.1	46.70	46.74	+0.1	51.55	51.47	−0.2
Lumber, 2x4 Pine, per M ft.	40.76	43.97	+7.9	40.68	40.76	+0.2	44.33	43.97	−0.8
Brick, common, per M	15.21	15.66	+3.0	15.26	15.21	−0.3	15.66	15.66	0
Ready-mixed concrete, c.y.	7.17	7.38	+2.9	7.15	7.17	+0.3	7.37	7.38	+0.1
Struct. clay tile, 3x12x12	75.65	78.93	+4.3	77.24	75.65	−2.1	78.47	78.93	+0.6
Paving asphalt, cars, ton	15.21	14.88	−2.2	15.10	15.21	+0.7	14.92	14.88	−0.3

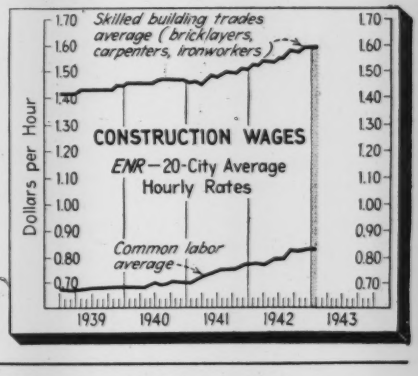
ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Jan., 1943	283.45	136.25	226.87	122.64	.....	.....
Dec., 1942	283.69	136.37	226.63	122.51	227	100
Nov., 1942	283.64	136.35	226.58	122.48	462	202
Oct., 1942	282.44	135.77	225.90	122.11	421	185
Sept., 1942	281.61	135.37	225.46	121.88	544	238
Aug., 1942	281.61	135.37	225.39	121.84	622	273
July, 1942	277.65	133.46	223.45	120.79	736	323
June, 1942	274.19	131.80	221.18	119.56	752	330
May, 1942	272.30	130.89	220.14	119.00	821	360
April, 1942	271.78	130.64	219.55	118.68	569	249
Mar., 1942	269.71	129.65	218.88	118.32	578	253
Feb., 1942	269.41	129.51	218.44	118.08	507	222
Jan., 1942	267.63	128.65	217.12	117.37	402	176
Dec., 1941	266.16	127.94	216.37	116.96	217	95
1942 (Av.)	276.31	132.82	222.39	120.22	553	243
1941 (Av.)	257.84	123.95	211.46	114.32	375	164
1940 (Av.)	241.96	116.31	202.81	109.64	269	118
1939 (Av.)	235.51	113.21	197.44	106.73	211	92

MATERIAL SHIPMENTS . . . . . BUILDING PERMITS

	December 1941	December 1942	% Change	Nov. 1942	% Change Nov.-Dec.
Lumber (% 1935–'39 wk. seas. av.) N. L. M. A.	121.3	141.6	+16.7	152.3	−7.0
Steel (% operating capacity) A. I. S. I.	96.5	98.3	+1.9	99.1	−0.8

	November 1941	November 1942	% Change	Eleven Months 1941	Eleven Months 1942	% Change
Fabricated structural steel, tons, A.I.S.C.	182,593	127,052	−30.3	2,074,963	1,885,695	−9.1
Cement, thous. bbl., U. S. B. of M.	13,724	14,627	+6.6	155,997	176,244	+13.1
Building Permits, Dun & Bradstreet (,000 omitted)	$92,283	$34,459	−62.7	$1,369,417	$758,089	−44.6



COST OF LIVING INDEX . . . . . EMPLOYMENT

	November 1941	November 1942	% Change	Oct. 1942	% Change Oct.-Nov.
Cost of Living Index, N. I. C. B.	92.9	100.3	+8.0	99.7	+0.6
Rent (Housing) Index, N. I. C. B.	89.5	90.8	+1.6	90.8	0
Total Employment (est.) thous., B. L. S.	35,926	38,437	+7.1	38,478	−0.1
Construction Employment (est.) thous., B. L. S.	2,469	1,911	−22.6	2,106	−9.3

ENGINEERING CONSTRUCTION VOLUME——ENGINEERING NEWS-RECORD——DECEMBER, 1942

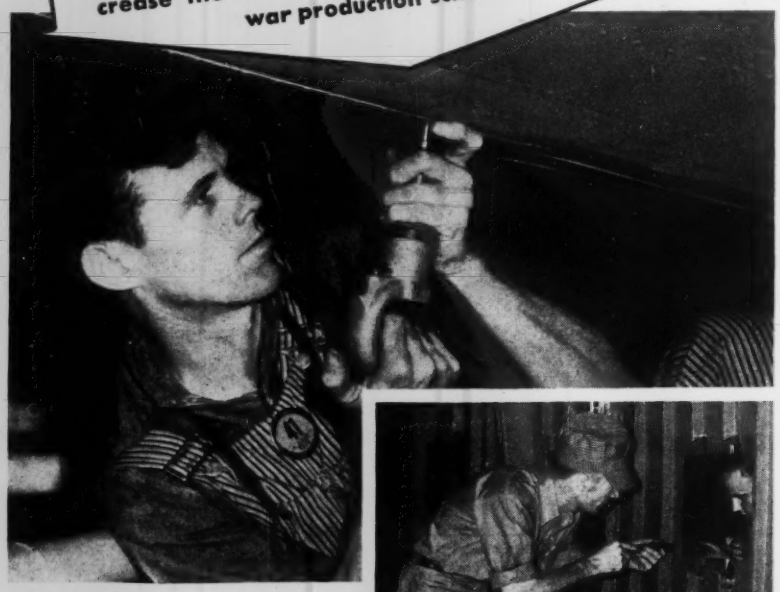
Engineering News-Record *reports projects of the following minimum costs—waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Five Weeks—Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States December 1942	United States Twelve Months 1942	United States Twelve Months 1941	Canada
Waterworks	662	557	5,401	218	2,512	1,549	10,899	150,965	76,698	720
Sewerage	275	460	1,347	136	1,718	1,192	5,128	118,437	88,719	1,147
Bridges, public	26	108	47	75	364	156	776	49,268	105,830	115
Earthwork and waterways	.....	346	364	.....	1,198	355	2,263	251,328	245,221	.....
Streets and roads	139	2,288	7,335	2,477	5,869	2,470	20,578	530,504	582,847	237
Buildings, public	6,862	21,337	88,620	24,694	26,655	32,623	200,791	5,678,103	2,785,585	3,176
Unclassified, public	20,051	10,599	35,845	1,813	16,456	35,144	119,908	1,971,401	805,717	2,532
Total public	**28,015**	**35,695**	**138,959**	**29,413**	**54,772**	**73,489**	**360,343**	**8,750,006**	**4,690,617**	**7,927**
Federal government (included in above classifications)	27,887	33,482	134,725	26,747	51,135	70,919	344,895	8,241,088	3,500,488	.....
Private										
Bridges, private	.....	.....	.....	.....	.....	.....	.....	890	5,798	.....
Industrial buildings	40	925	.....	1,555	598	731	3,849	200,319	496,176	4,522
Commercial buildings	.....	2,784	400	1,536	1,140	2,164	8,024	291,703	485,683	.....
Unclassified, private	25	550	75	15	708	33	1,406	62,911	190,425	.....
Total private	**65**	**4,259**	**475**	**3,106**	**2,446**	**2,928**	**13,279**	**555,823**	**1,178,082**	**4,522**
Total Engineering Construction:										
December, 1942—5 weeks	**28,080**	**39,954**	**139,434**	**32,519**	**57,218**	**76,417**	**373,622**	.....	.....	**12,449**
November, 1942—4 weeks	22,111	93,218	117,863	112,447	155,244	106,739	607,622	.....	.....	12,072
December, 1941—4 weeks	15,181	73,813	47,689	40,115	50,515	42,376	269,689	.....	.....	17,596
Twelve Months—1942	**466,976**	**1,225,390**	**1,930,172**	**1,587,922**	**2,466,930**	**1,628,439**	.....	**9,305,829**	.....	**225,148**
Twelve Months—1941	311,709	1,211,361	1,245,275	908,630	1,345,177	846,547	.....	.....	5,868,699	262,532

WHO SAYS FLOORS MUST ALWAYS BE DARK?

Pictures show two reasons why floors should be light in color—how white cement floors greatly increase the amount of useful light, thus speeding war production schedules.



Tests at Consolidated Aircraft Corporation, Fort Worth, prove that the white cement floor compared to the gray cement floor in this plant reflects 61% more light to the under side of wings and fuselage (*upper picture*) and 20% more light to vertical work surfaces (*lower picture*).

MOST floors are dark. That's because a floor has been thought of only as a space to walk, work or put things on. But today *dark* floors are being recognized as giant blotters or robbers of light, and *light-colored* floors as giant reflectors or conservers of light—reflectors that greatly increase the amount of comfortable, useful, productive light throughout the working area.

General Electric Lighting Engineers tested the efficiency of light-reflecting floors at Consolidated Aircraft Corporation, Fort Worth. Their tests show that this floor reflects 61% more light to under-side working areas and 20% more light to vertical work surfaces than did the gray cement floor in the same plant.

Write for LIGHT FROM FLOORS—a new 24-page book containing lighting data, advantages of white cement floors, and construction and maintenance information of real value to contractors, architects, engineers and owners. Mail the handy coupon today. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

OFFICES: *New York, Chicago, Philadelphia, Boston, Albany, Pittsburgh, Cleveland, Minneapolis, Duluth, St. Louis, Kansas City, Des Moines, Birmingham, Waco.*

ATLAS WHITE CEMENT

FOR LIGHT-REFLECTING FLOORS

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Cement Company
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New York, N. Y.

Please send me copy of new book, "Light from Floors."

ENR-F-9

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The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • JANUARY 14, 1943 • VOLUME 130 • NUMBER 2

Formulate rules for handling construction under CMP

War Production Board's new Facilities Bureau will act as claimant agency for constructors under new materials control plan. Definite rulings for industry due soon.

A detailed regulation governing the distribution of materials to construction projects under the Controlled Materials Plan will be issued by the War Production Board within the next week or two. Already, however, forms to be used are available and the broad outlines of procedure are clear.

The Controlled Materials Plan is the new scheme for allocation of steel, copper, and aluminum that WPB intends to put partially in operation in the second quarter of this year. In the third quarter, none of the three metals will be delivered except under the terms of the CMP.

Basic feature of CMP is that the WPB Requirements Committee, having before it estimates of the future month-by-month production of the three "controlled materials", will divide up each month's production among thirteen "claimant agencies"—Army, Navy, Agriculture Department, Petroleum Administrator, etc. Each of these agencies will then allot its share among the metal-users over whom it has jurisdiction. The Army, for instance, will make allotments to each of its prime contractors for munitions. These in turn will allot part of their allotment to their sub-contractors.

Procedure for construction

As to construction, WPB's Facilities Bureau has been designated as the claimant agency. The Facilities Bureau, of which Fred Searls, Jr., is chief, (*ENR*, Nov. 19, 1942, p. 689) includes the Construction Bureau (from the directorship of which William V. Kahler resigned this week) and the Facilities Clearance Board and Facilities Review Committee (*ENR*, Oct. 29, 1942, p. 597) headed by Col. Gordon B. Textor.

It is already true that all proposed construction projects must be reviewed by one of these facilities units. From the information so gathered, the Facilities Bureau in every quarter will present to the Requirements Committee a program of construction and a claim on the steel, copper, and aluminum needed to carry it out. The Requirements Committee will approve part or all of this claim and make an allotment to the Facilities Bureau of a definite tonnage each month.

Information from owners

Facilities Bureau will then obtain from the owner of each construction project an application for an allotment. This application, on Form CMP-3C, will identify the project, show the dates when construction is to start and be completed, and set forth a month-by-month statement of the deliveries of materials needed to meet this construction schedule. These deliveries must be so figured as not to result at any time in the accumulation of more than a 60-day inventory.

The owner, of course, would not ordinarily have the information on required material deliveries. He gets it by having his construction contractors and suppliers fill out and submit to him forms CMP-3C. Then he coalesces the information to fill out his own form.

On the basis of the application from the owner, the Facilities Bureau turns over to him an allotment number entitling him to a definite quantity of material in each month—all the material which will be used on the entire project. Then the owner makes sub-allotments to his prime contractors for the amounts they will need. In many cases they, in turn, may have to allot part of their material to their own sub-contractors.

No early action on construction

Because of the delay inside WPB in deciding how to handle construction, it is unlikely that much construction work will come under CMP in the second quarter. Theoretically, this does no harm; construction men simply continue to buy materials as formerly under priority ratings. In practice, it may cause considerable embarrassment, because allotment numbers take precedence over all priority ratings except AAA. Thus, if shortages develop during the second quarter, it will be the metal-users not under CMP who go short.

$7 billion in budget for construction

Preparation of the federal budget in wartime is hardly more than an example of the force of habit. The military expenditures, which make up most of it, are veiled in secrecy and in any event can't be predicted 18 months in advance. Nevertheless, the President this week submitted to Congress a 108 billion dollar budget for the fiscal year ending July, 1944; nearly two-thirds of it was contained in two unanalyzed items: $23 billions for the Navy, $53 billions for the Army.

On construction, it is known that the budget contemplates federal expenditures in fiscal 1944 of about $7 billions. However, only the less than half billion for civil public works is broken down at all.

Actual expenditures for public works for the fiscal year are expected to run to about $354,612,000 as compared with $576,752,000 in the current year and $619,962,000 in fiscal 1942. Almost all of this, however, will consist of winding up the spending of money previously appropriated. New appropriations asked amount to only $72,686,000.

Significant appropriations asked include: $40,000,000 for federal aid highways (the only money for roads); a total of only $2,145,000 for reclamation; and $14,000,000 for Mississippi flood control.

Illustration of the difficulty in pinning down wartime expenditures to a budget even as regards non-military work came before the ink on the President's budget message was dry. Two days after submitting the budget to Congress, the President asked for an additional $40,000,000 to be immediately appropriated to the FWA for the construction of access roads. This is in addition to the $74,600,000 which is already available in the present fiscal year.

Highway department budgets reflect anticipated drops in tax revenues

Road bureaus show results of careful planning as they submit budget requests for new year centering on maintenance and postwar plans

Continuing prospects of decreased revenue for highway purposes has brought additional evidences that state highway departments throughout the nation are making comprehensive plans to meet the situation in a manner that will provide greatest safety during the war period, and yet keep the roads in condition for further improvement and expansion immediately after the war.

Governor J. M. Broughton, in an annual message to the North Carolina State Legislature, requested that provisions be made for putting a badly needed highway construction and improvement program into effect at the end of the war.

"War conditions have had an adverse effect upon our highway funds," the governor said. "Gasoline and tire rationing, sharp limitations in the use of passenger cars and trucks and other circumstances have brought about the most drastic cuts in highway revenues experienced since the creation of the Highway Commission. The curve is still downward and highway revenues for the coming biennium will probably be substantially less than 50 percent of normal.

Roads will need improvement

"By the end of the present emergency period, our highways will be badly in need of repairs and improvements, and much new construction of bridges, causeways and additional highways, as well as widening and straightening of many existing highways. Furthermore, a program of public work of this character will be needed to give employment to our people who would otherwise be unemployed.

"In view of these contingencies, I recommend that the legislature confer upon the governor and council of state full authority at the expiration of the present war to cancel highway bonds owned by the state and held in such reserve fund, to reduce to that extent the outstanding highway indebtedness, and to issue, within the constitutional limits, new highway construction bonds to the extent of two-thirds of the bonds cancelled and redeemed during the biennium.

"Such a plan put into effect at the end of the war would immediately give to the highway commission a fund of about 15 million dollars, plus available federal funds, for new and badly needed highway construction and improvements."

In California, C. H. Purcell, who recently was appointed director of public works for the state, announced that plans for expected radically changed traffic requirements in the days of peace will keep pace with necessary strategic maintenance and construction of highways during the war period.

Purcell said that despite an expected $29,000,000 drop in highway revenue during the next biennium, his department would be able to maintain highways in repair and continue the resurfacing of important highways to avoid costly major replacements at later dates. He said also that plans for the future will continue to be made.

Louisiana looks to postwar

W. Prescott Foster, director of highways for the State of Louisiana, announced recently that the Public Roads Administration has made available to the state $147,961 for advanced engineering studies in connection with proposed postwar projects.

The money made available is to be matched by the state government to plan a program that includes bridging the Mississippi river at New Orleans in the area of Canal St. Of the amount, $70,000 will be used for advanced engineering studies of traffic problems in the New Orleans municipal area, and the rest for other projects.

At Frankfort, Ky., J. Lyter Donaldson, state highway commissioner, said that construction in 1943 will be limited to routes that are vital to war activities. The highway department, which spent about $11,000,000 for construction and maintenance in 1942, has about $5,000,000 set aside to complete planned jobs in 1943.

Arkansas State Highway Director W. W. Mitchell announced that he would recommend to the highway commission two highway budgets for submission to the 1943 legislature. One would be based on restricted wartime construction and another on a major post war building program. As long as the war continues, highway work will be restricted by regulation of the federal government to routine maintenance and war plant access roads, Mr. Mitchell said, but there will be a big need for highway building to absorb workers after the war is over.

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N. J. inland waterway section completed

Providing the last link in an unbroken string of protected waterway from Manasquan Inlet, New Jersey to southern Florida, the waterway of the $1,000,000 Cape May County (N. J.) Canal was completed recently.

Kahler resigns WPB construction post

William V. Kahler, director of the Construction Bureau of the War Production Board, has resigned in order to rejoin the Illinois Bell Telephone Co., with which he has been associated for nearly 20 years. He has been on leave for more than two years from the position of chief engineer for the Chicago area of the company while serving in various war capacities. Pending appointment of a successor, he will remain at WPB.

Mr. Kahler was appointed chief of the Construction Bureau when it was formulated in April, 1942 (*ENR*, April 16, 1942, p. 583).

H. K. Ferguson officials evaluate 1943 prospects

Somewhat over normal but considerably less than the past two years is the outlook for 1943 in the industrial engineering and building field, according to Harold K. Ferguson, president, H. K. Ferguson Co., Cleveland. Emphasis will be placed on what we are now regarding as "small" jobs—jobs costing less than a million dollars although undoubtedly there will be a few sizable new plants in all industries. Also, says Mr. Ferguson, the trend will be to convert old plants to war work rather than to build new ones. "As the demands of our overseas forces grow, we will find that contracts will be awarded for plant expansions and additions rather than for entirely new plants, and in some industries the expansion programs will be large."

C. A. Harwick, vice-president in charge of engineering of the Ferguson Co., believes that one of the really big problems of 1943 will be holding onto existing organizations, in the face of declining construction, while J. Stuart Sneddon, vice-president in charge of construction, foresees the government using greater selectivity in the types of war construction that are demanded. "Rather than continuing to foster a general industrial construction program to provide total, over-all production, the government in the future will be specific in wanting more steel capacity, greater tank production, more fighting planes—more of anything where deficiencies are found to exist," says Mr. Sneddon. Furthermore, new construction for the war effort will be spread out over a possible period of two to three years, depending upon how long it takes to win the war, instead of being rushed to completion at the terrific pace we have known these past months.

WPB cancels work on sixty-five river and harbor and flood control projects

$249,000,000 work of Engineer Corps halted by new order. Reclamation Bureau faces long litigation over stopping of its projects

The War Production Board last week cancelled priority ratings and ordered work stopped on 65 river and harbor and flood control projects. The value of the still-uncompleted work on the river and harbor projects stopped is estimated at $89,000,000. About $160,000,000 worth of work remained to be done on the halted flood control projects.

About half of these projects had already been stopped voluntarily by the Corps of Engineers. Among the larger jobs halted are the following:

Arkansas—Blue Mountain reservoir; California—five flood control projects on the Sacramento River involving levee reconstruction and other work, and protection work on the Napa, San Gabriel and San Joaquin Rivers; Colorado—John Martin reservoir; Connecticut—protection work at Bridgeport and on the Thames River; Kentucky—protection work at Paducah; Louisiana—Wallace Lake reservoir; Massachusetts—Birch Hill and Knightsville reservoirs; Minnesota — Lac Qui Parle reservoir; Missouri —Clearwater reservoir; New Hampshire —Surry Mountain reservoir; and Mississippi River—Flood wall at Cairo, Ill., Bayou Sorrell lock, Morganza floodway, Yazoo backwater levees, levee at Morgan City, La., and corrective dredging of the Atchafalaya River.

Certain work was permitted to continue on nine of the projects, in each case exceptions being made for construction "solely for purposes of safety or health or to avoid undue damage or deterioration." Exceptions included:

Kentucky—Wolf Creek reservoir, construction necessary to complete excavation of cut-off trench; West Virginia—Bluestone reservoir, work needed inside first cofferdam to prevent its possible loss; and certain parts of flood control protection works at Kansas City, Wilkes-Barre and York, Pa., Cincinnati, Ohio and Memphis, Tenn.

Additional preference rating orders revoked included one issued to the Wyoming State Highway Department for construction of an overpass at Rock Springs.

All of the Corps of Engineer construction contracts carried the standard War Department cancellation clause. The Bureau of Reclamation is not so fortunate. After a month or more of resistance, the Bureau has now shut down the projects ordered terminated some time ago by WPB (*ENR*, Dec. 17, 1942, p. 829). It now faces the job of straightening out some two or three hundred contracts of all types, hardly any of which carried cancellation clauses.

The Bureau hasn't yet decided just what it's going to do. It may simply suspend some of the contracts for the duration, but many of them will undoubtedly have to be terminated. No final decision has yet been reached whether to offer the contractors some standard form of termination agreement or to rely on the courts. Probability is that the bureau will attempt to settle on the basis of the cancellation clause contained in the Davis Dam contract. This, in essence, provided that the contractor receive his costs for work performed under the contract plus 10%.

Such an agreement might solve much of the problem, but some contracts will undoubtedly go into the courts.

A TWELFTH generator, adding more than 75,000 kw. to the battery in operation, has been placed in operation at Boulder Dam, to bring the total capacity of the plant to more than 950,000 kw., according to Commissioner John C. Page of the Bureau of Reclamation.

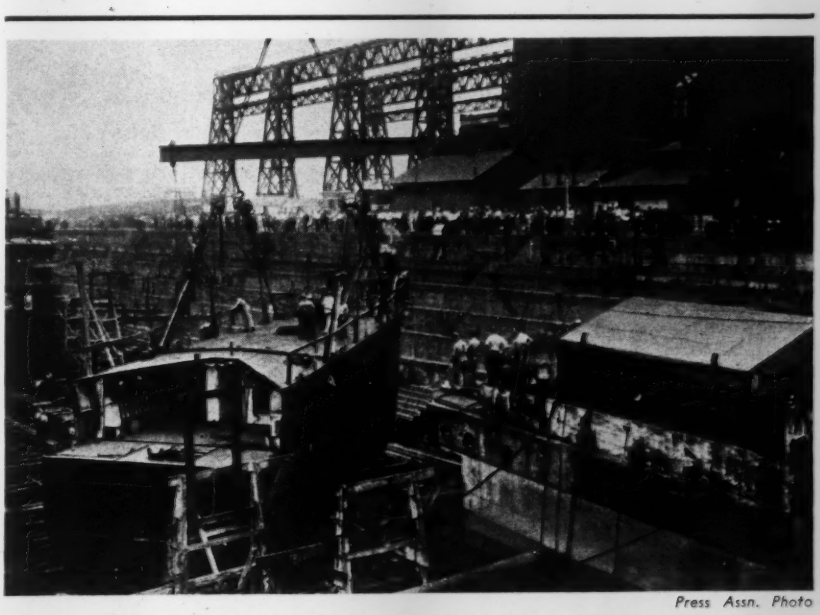
New pumps bolster water system in Philadelphia

Philadelphia's antiquated water system has received a temporary relief as the result of an agreement between city officials and War Production Board engineers who said they would recommend that the city be permitted to purchase about $1,250,000 worth of equipment.

This will include five pumps, three high capacity chlorinators and pipe for extension and repair of mains.

The city has long been seeking means of repairing or replacing its water system, which has for some time been cause for alarm on the part of water department engineers who fear the system cannot withstand further heavy drains of war industries (*ENR*, July 30, 1942, p. 43, and previous) in its present condition.

New equipment authorized includes three new motor driven centrifugal high service pumps at the Torresdale pumping station, two new pumps at the Lardner's Point pumping station, installation of three high-capacity chlorinators at the Torresdale filter plant, extension of 4,130 ft. of 12-in. dia. cast iron pipe and 290 ft. of 8-in. dia. cast iron pipe in the Fort Richmond district, and replacement of 756 damaged fire hydrants of obsolete type for which repair parts cannot be obtained. The additions were characterized as a "minimum program."



Press Assn. Photo

Damaged warship gets bow from sister ship

The U.S.S. Blakeley, shown at extreme left in the above photograph, managed to limp home to an East Coast navy yard after its bow was sheared off in an engagement with an enemy submarine in the Caribbean Sea.

Rather than wait for construction of a complete new bow section, engineers at the yard cut the bow off the destroyer Taylor (at right), a sister ship of the Blakeley that has been decommissioned for some time.

Welders cut the bow from the Taylor according to exact specifications, making similar cuts on the Blakeley. A big overhead crane, swung the bow section from one ship to another.

Frank Darrow retires as C. B. & Q. chief engineer

Frank T. Darrow has retired as chief engineer of the Burlington Lines after 45 years of service with the railroad. He will be succeeded by Herbert R. Clarke, according to announcement by H. C. Murphy, assistant vice president.

Mr. Darrow began his long engineering career with the Burlington as a draftsman at Lincoln, Nebr. in 1897, following graduation from Allegheny College, Meadville, Pa. Two years later he had risen to the position of division engineer, and was associated with the construction of many Burlington lines and improvements in the West. He was appointed engineer of maintenance of way at Lincoln in 1905 and principal assistant engineer in 1907. In 1918 he became assistant chief engineer with headquarters at Lincoln, and moved to Chicago in 1937 to become chief engineer of the system. During the past three years his responsibilities also included the Colorado & Southern, Fort Worth & Denver City, and Wichita Valley railways.

F. T. Darrow

H. R. Clarke

Mr. Clarke entered the Burlington service as a rodman in 1907, after graduating from Monmouth College, Monmouth, Ill. He served as roadmaster at several points from 1911 to 1919, when he became general roadmaster at McCook, Nebr. In 1921 he was appointed district engineer of maintenance of way at Lincoln, and in 1925 became general inspector of permanent way at Chicago. He was promoted to engineer of maintenance of way in 1932 and became chief engineer of maintenance of way in 1942. In his new position he will have charge of both engineering and maintenance of way.

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Start moving oil in "Big Inch" line test

The initial batch of crude oil is now moving into the 24-in. War Emergency Pipeline at Longview, Tex., Petroleum Administrator for War Harold L. Ickes announced Jan. 6.

"The line-filling operations were started on New Year's eve, and despite washed-out river crossings, delay in deliveries of materials and other bad breaks that have hampered completion of the 'big inch' pipe, oil was placed in the line on schedule," Mr. Ickes said. "Actual delivery of this first batch of oil at the Norris City, Ill., terminal (*ENR*, Dec. 31, 1942, p. 915) must await repair and completion of the washed-out Mississippi River crossing, but by pumping oil into the lower section of the pipeline while the break is being repaired, much time will be saved."

Officials of the Petroleum Administration for War said the line filling operation will proceed just as fast as block gates are installed ahead of the oil stream. According to the present estimates, the 24-in. pipeline will be delivering about 90,000 bbl. a day at the start. Throughput will be advanced progressively with the completion of additional pumping stations, and deliveries should hit about 150,000 barrels daily when three to four stations are operating. Rapid completion of all eleven pumping stations planned for installation between Longview, Tex., and Norris City is now expected.

The washout referred to by the petroleum administrator occurred at the Mississippi river crossing, when 600 ft. of the pipe was damaged by a rise of 15 ft. in the river. Construction of the crossing was well advanced, and completion expected Dec. 30, when the accident occurred.

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Sanitary engineers listed as essential workers

Sanitary engineers and bacteriologists are now recognized by the Selective Service System as being engaged in a critical occupation. This means that such men, if they are found by their local draft board to be engaged in activity essential to the war or in essential civilian activity, are eligible for occupational deferment from the draft. These groups were recognized as critical in an amendment to Selective Service's occupational bulletin 10, under which civil engineers and transportation engineers—air, highway, rail, and water—are already recognized as critical. Bulletin 10 also provides for the deferment of students who have completed a year of training in one of the critical occupations. Teachers of all engineering sciences have been recognized as critical for some time under Bulletin 23, which has just been amended to include also graduate instructors putting in at least 12 hours a week of teaching or research. A new Bulletin, No. 43, recognizes as critical all professional and technical engineers and designing draftsmen if they are serving establishments engaged in war production.

Research Council sets up sanitary engineer group

The National Research Council recently announced that it had set up a sanitary engineering committee, at the request of the Surgeon General of the Army.

Through liaison officers, advice and assistance in regard to sanitary engineering problems are to be furnished to the Navy and the Public Health Service as well as to the Army. Members of the committee, which was formed with regard to epidemiological and entomological experience and training, are: Abel Wolman, chairman, professor of sanitary engineering at Johns Hopkins University; Kenneth D. Maxcy, secretary, professor of epidemiology, at the School of Hygiene and Public Health, Baltimore, Md.; Harold E. Babbitt, professor of sanitary engineering, University of Illinois; F. C. Bishop, assistant chief, Bureau of Entomology and Plant Quarantine, U.S.D.A.; V. M. Ehlers, chief engineer, Texas State Board of Health; Gordon M. Fair, professor of sanitary engineering, Harvard University; and H. A. Whittaker, chief engineer, division of sanitation, State Department of Health, Minneapolis, Minn.

In its several meetings to date, the committee has devoted major efforts to the problem of procurement and training of the large number of sanitary engineering personnel required for essential war activities.

The committee has also considered the sanitary engineering functions performed by the Sanitary Corps of the Army with a view toward providing constructive suggestions on many problems occasioned by the war, including the safeguarding of Army water supplies, disposal of waste and malaria control. The program covering future activities includes a continuation of its present work; the orderly procurement of and assignment to military, semi-military and civilian agencies of trained sanitary engineers; information on military sanitary engineering problems and their solution; and a consideration of postwar needs for sanitary engineers and the fields in which they may be most profitably utilized.

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Start dredging on Florida intracoastal waterway

Dredging operations were started recently to enlarge the navigable dimensions of the intracoastal waterway from the vicinity of Rigelets, La., to Carrabelle, Fla., at an estimated cost of $2,795,000, according to Col. Doswell Gullatt, U. S. engineer for the Mobile, Ala., district.

WASHINGTON HIGHLIGHTS

ALL construction projects granted a rating of AA-4 by a P-19 order have been rated upward to AA-3 by the WPB. At the same time all war housing projects, public or private, which have been granted any rating on a P-55, P-19-d, or P-19-h order are up-rated to AA-3. In each case, it is up to the builder to re-rate his contract in accordance with the procedure of Priorities Regulation 12 and notifying his suppliers of his new rating.

CONCRETE reinforcing bars available in future will consist almost entirely of bars re-rolled from rail. In order to keep the re-rolling mills busy in the face of a declining demand, WPB has forbidden steel mills (except those on the West Coast) to produce reinforcing bars in sizes rolled by re-rolling mills. Bar production is currently at about 75,000 tons a month as compared with an average of 150,000 tons last year.

TO BE eligible for advanced engineering training under the Army training program, an inductee must have had a year of college work and must achieve a score of 110 on the Army Classification test. High school graduates under 22 who achieve this score are eligible for less advanced training.

USED construction equipment may not be exported from the continental United States without permission of the WPB and the BEW, under an amendment to order L-196.

AT THE invitation of Lt. Gen. Brehon B. Somervell, a group of presidents and deans of engineering colleges and universities this week visited the Army's Aberdeen Proving Grounds in Maryland to observe Army methods of training Ordnance personnel.

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Appoint new California highway engineer

Charles H. Purcell, recently appointed California state director of public works (*ENR*, Dec. 31, 1942, p. 892), recently announced appointment of George T. McCoy as state highway engineer, and A. H. Henderson as assistant director of the department of public works.

Mr. McCoy has been assistant state engineer for ten years, and fills the position vacated by Purcell when the latter was given the public works directorship. Mr. Henderson has been in the state service for 24 years, his last post being disbursing officer of the division of highways.

Born in Oregon, Mr. McCoy has had thirty years of highway engineering experience with the U. S. Bureau of Public Roads and the state highway systems in North Dakota, Idaho, Washington and California. He came to the California highway department in 1927 as assistant office engineer, and was promoted to assistant state highway engineer in 1928.

Fred J. Grumm, a member of the state highway staff since 1922, was named to succeed McCoy as assistant state highway engineer.

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Construction applicants urged to use WPB services

Considerable saving in time and money on the part of applicants for substantial construction projects can be effected by using preliminary services of the Materials Control Branch of the Construction Bureau of the War Production Board.

Architects, contractors and others who have preliminary drawings and approximate lists of materials available, may consult with WPB before making final drawings and submitting formal application to begin construction. In this way the builder can be advised of the latest regulations regarding use of materials and make whatever corrections are necessary in order to conform. Later, when he is ready to file his formal application for priority assistance on Form PD-200, he should be able to give all information asked for on the form and in the manner designated in the instructions.

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Mexican shipyard will build, repair vessels

Awarding of a contract-concession to Astilleros del Golfo, S. A., a recently organized Mexican drydock and shipyard construction company, for the establishment of a shipyard on Mexico's East Coast to construct vessels up to 15,000 tons and repair naval and merchant craft, has been announced by Gen. Heriberto Jara, Secretary of the Navy.

The yard is to cost about $825,000, and the contract demands that it must be completed within two years from the start of construction. The concession is for 20 years, whereafter the business will become the property of the Mexican government. The company must repair vessels of Mexican registry at half the charges it will make foreign craft, and maintain its equipment and machinery in first class condition so that the entire plant will be an asset when it is turned over to the government.

Sodium chlorate to be available without priority

Sodium chlorate will be available for weed eradication in 1943 in quantities sufficient to care for major needs without rigid state quotas, according to a joint announcement by the Department of Agriculture and the War Production Board. The chemical will be distributed in the regular commercial channels as equitably as possible according to the demand and need, the announcement advised.

Since the supply is not yet equal to the demand, the material is still subject to allocation by the War Production Board, but the Agriculture Department made clear that the situation is easier than a year ago and that, barring unforeseen contingencies, there will be a "comfortable" quantity for use.

State and local authorities responsible for the purchase of sodium chlorate are asked to take steps to see that orders are placed in an orderly and regular manner, since there is no occasion for premature buying or hoarding. Reasonable notification of intention to order is recommended as a means to assist manufacturers in arranging deliveries. Prices of sodium chlorate, covered by maximum price regulations of the Office of Price Administration, will remain the same as last year.

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WPB tally shows scrap shipments on rise

Shipments of iron and steel scrap to consuming mills from July through October were 57.7 percent of the nation's quota of 17,000,000 tons for the last six months of 1942, according to Paul C. Cabot, deputy director of the War Production Board's Conservation Division.

The October shipments totaled 2,762 net tons, which had the effect of increasing consumers' inventory of purchased scrap during the month by about 460,000 net tons—to a point 47 percent higher than inventories in the hands of consumers at the same time last year.

Mr. Cabot pointed out that available data covers only actual shipments through October and does not reflect the collections of scrap made during that month. Dealers' inventories of scrap, although considerable, will not be included until the end of the year, and scrap in community piles is also known to have been considerable at the time the last figures were made but is not to be included until moved into dealers' yards.

Meanwhile, the Edison Electric Institute reported that scrap drives in continuous salvage programs of the electric utility companies in 1942 netted 24,000,000 lb. of copper for the war effort.

Ellison, Minnesota road department official, dies

Jay T. Ellison, 61, assistant commissioner and chief engineer of the Minnesota State Highway Department, and a member of the executive committee of the National Association of State Highway Officials, died Dec. 25.

Jay T. Ellison

He had served as an assistant commissioner of the Minnesota department since the establishment of the state's trunk highway system in 1921, first as second assistant commissioner and chief bridge engineer—from 1921 to 1925—and since that time as assistant commissioner and chief engineer. A native of Minnesota, he was a civil engineering graduate of the University of Minnesota and began his professional career as a mining engineer for the Shenango Furnace Co. of Chisholm, Minn.

Mr. Ellison entered the State Highway Department in 1911 as an engineer in the bridge division, became a district engineer in 1916, and in 1917 was appointed chief bridge engineer, assuming charge of all bridge plans and construction on state-aid roads.

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California hydro-plant placed in operation

A new hydroelectric generating station has been placed in operation recently by the Pacific Gas & Electric Co., within little more than a year since its construction was started.

The new powerhouse, built on the Yuba river, will add 14,700 hp. to the system's capacity. It is a part of a long term building program planned in 1938. Three other powerhouses will be completed and placed in operation within the next twelve months. Early in February, a second hydroelectric station will be completed in Placer county, producing 37,000 hp. Third of the projects is an additonal unit being installed at an existing plant on the shore of San Francisco Bay. A fourth project now under construction is a hydroelectric plant on the Pit River to have an installed capacity of 200,000 hp., the largest of all the hydroelectric generating stations in the system. Work on this plant began in July, 1941, and it is now 70 percent completed.

When the four new units, which are now under construction, are completed, the company will have a total of 64 generating stations.

JOBS OF THE WEEK

HOUSING, Maryland
Alley Dwelling Authority, Washington, D. C., received low bids for Calvert Houses, in Maryland, from B. W. Construction Co., Chicago, Ill., at $1,519,000. Skidmore, Owings & Merrill, New York, are architects.

HOUSING, Messena, N. Y.
Public Housing Authority, New York, N. Y., received lowest bid on housing projects from A. J. Paretta Construction Co., Long Island City, N. Y. $1,344,000. Mayer & Whittlesey, New York, are architects.

HOUSING, Texas
U. S. Engineers, Fort Sam Houston, housing, low bid from A. Farnell Blair, Decatur, Ga. Estimated cost, to exceed $5,000,000.

HOUSING, California
Alameda Housing Authority, Alameda, awarded contract for two housing projects to F. C. Stolte Co., Alameda. Including rough grade and fill, first project will cost $2,447,899; second, $1,332,668. Andrew T. Hess, and C. I. Warnecke, Oakland, are architects. George E. Atkins, San Francisco, is engineer.

HOUSING, California
Richmond Housing Authority, Richmond, awarded contract to Oliver M. Rousseau, San Francisco, at $2,131,613. Project is housing, Contra Costa County. Carl L. Warnecke, Oakland, Gaffrey E. Bangs, San Francisco and Vincent G. Raney, San Francisco, are architects. NHA.

HOUSING, Virginia
Public Housing Authority, NHA, Washington, D. C., received lowest bid on housing project, Arlington County, from Person Construction Co., Chicago, Ill., $1,057,000. Heaton & Chatelain, Washington, D. C., are architects.

HOUSING, South Carolina
Charleston Housing Authority, Charleston, awarded contract on housing to Skinner & Ruddock, Charleston, $2,250,800. Douglas Ellington, Charleston, is architect, NHA.

HOUSING, Oregon
Portland Housing Authority, Portland, housing, including water, sewer, power distribution lines, Umatilla County. Bid from C. F. Davidson Co., Tacoma, $1,189,800. Roi Morin, Portland, Ore., is architect. NHA.

HOUSING, Georgia
Housing Authority of City of Savannah, received lowest bid for constructing housing project from P. S. West Construction Co., Statesville, N. C., $1,544,000. Celtus W. Bergen & Associates, Savannah, are architects.

DRYDOCK, New Jersey
Bureau of Yards & Docks, Navy Dept., Washington, D. C., two 1,000 ton timber dry docks to Underpinning & Foundation Co., New York, N. Y. $2,390,000.

MILITARY INSTALLATION, Arkansas
U. S. Engineers, Little Rock, Ark., awarded contract buildings and water distribution system in connection with military installation, to Peterson & MacFadyen and Colin McGregor, Little Rock. To exceed $3,000,000.

Note—Additional bidding and contract news on many projects large and small appear in the Construction News section beginning on page 219.

AGC board meeting replaces convention

A meeting of the governing and advisory boards of the Associated General Contractors of America will be held at the Drake Hotel, Chicago, Ill., on Feb. 15–16, instead of the 24th annual convention, according to Managing Director H. E. Foreman.

The decision to hold the meeting of the boards instead of the convention was made as an aid to the war effort (*ENR*, Dec. 24, 1942, p. 878).

Installation of new officers and directors for 1943 will take place at the meeting. The fall board meeting nominated Oscar B. Coblentz, of Baltimore, Md., for president, and William Muirhead of Durham, N. C., as vice president.

New Moscow subway line in operation

A new 4-mile subway line linking the center of Moscow, Russia, with the industrial section of the southwestern suburbs, has been opened for service, according to recent dispatches from the Russian capital.

The new route is the third line of the Kaganovich underground system, opened in 1935. Construction started before the war, and continued during the air raids, many women having replaced men in the construction work.

The stations are said to be done in white Georgian marble, with black and brown granite pillars and mosaic paneled walls depicting the industrialization of the Soviet Union.

OBITUARY

Nathan Schein, 58, for 35 years a civil engineer for the Pittsburgh Department of Public Works and for 20 years secretary of the Pittsburgh section, American Society of Civil Engineers, died Jan. 8 at Pittsburgh. At his death Mr. Schein was a consulting engineer on construction for the Dravo Corp.

Harold L. Brigham, president of the New England Water Works Association, and superintendent of the Marlboro, Mass., water department, died at a Brookline, Mass., hospital Jan. 8. He was 48 years old.

W. G. Phipps, a civil engineer in government service, died recently at Columbus, Ohio. Mr. Phipps had been employed at the Meridian, Miss., air base, and was in Columbus to assist in construction of an airfield there.

Henry S. Elliott, head of the bureau of plans and surveys for the Oklahoma state highway department, died in Oklahoma City recently.

Harry Thomas Paterson, civilian civil engineer with the U. S. Army District Engineer's Office at Wilmington, N. C., died at Wilmington recently. He was 68.

Robert H. Hughes, 51, a consulting engineer of Baltimore, Md., died Jan. 4 of injuries sustained in an automobile accident.

Harold J. Engstrom, 58, of Little Rock, Ark., a civil engineer for the Arkansas highway department, died Jan. 4.

Clarence S. Solberg, Minneapolis, Minn., construction engineer and contractor, died there recently at the age of 55.

Harry B. Nelson, Sr., 57, head of an Atlanta, Ga., construction company, died in Atlanta recently.

Kenneth Gordon, 68, construction engineer of West Hartford, Conn., died there Jan. 7. Mr. Gordon, vice president of Marc Eidlitz & Sons, Inc., New York, supervised construction of many important buildings including large insurance buildings in Hartford, the Sterling Library and Harkness Memorial at Yale College and others.

Michael E. White, head of White Consolidated, Inc., road construction firm of Milwaukee, Wis., died at Boynton Beach, Fla., recently. He was mayor of Boynton Beach at the time of his death.

John Chasteen, 73, retired contractor, died at Lexington, Ky., recently.

CONTRACTS AND CAPITAL

ENGINEERING CONSTRUCTION volume for the week, $53,113,000, is 36 percent below the total for the corresponding 1942 week, and 17 percent under last week's total. Private volume is 75 percent lower than a year ago, and 44 percent under a week ago. Public construction declines 30 percent from last year, and is 15 percent below last week as both federal, and state and municipal work decreased.

The current week's total brings 1943 construction to $117,041,000, an average of $58,520,000 per week. On the weekly average basis the 1943 volume is 37 percent below that for the three-week period in 1942. Private work is 57 percent lower, and public construction is down 35 percent from a year ago, when adjusted for the difference in the number of weeks.

In the classified construction groups, gains over last week are in sewerage, earthwork and drainage, and unclassified construction. Unclassified construction is the only class of work to report an increase over the 1942 week.

New capital for construction purposes for the week totals $154,000, entirely state and municipal bond sales. This compares with $11,005,000 for the week last year.

New construction financing for the year to date, $678,000, compares with $478,692,000 in the opening three weeks of 1942.

CONTRACTS

(Thousands of dollars)

	Week Ending Jan. 15 1942	Jan. 7 1943	Jan. 14 1943
Federal	$56,909	$51,934	$49,827
State & Municipal	14,827	6,877	420
Total public	$71,736	$58,811	$50,247
Total private	11,526	5,117	2,866
TOTALS	$83,262	$63,928	$53,113

Cumulative
1943 ..... (2 weeks) $117,041
1942 ..... (3 weeks) $279,446

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1942 3 weeks	1943 2 weeks
NON-FEDERAL	$28,692	$678
Corp. Securities	1,800	.....
State & Mun.	16,592	678
R.F.C. loans	10,300	.....
FEDERAL	$450,000	.....
TOTAL CAPITAL	$478,692	$678

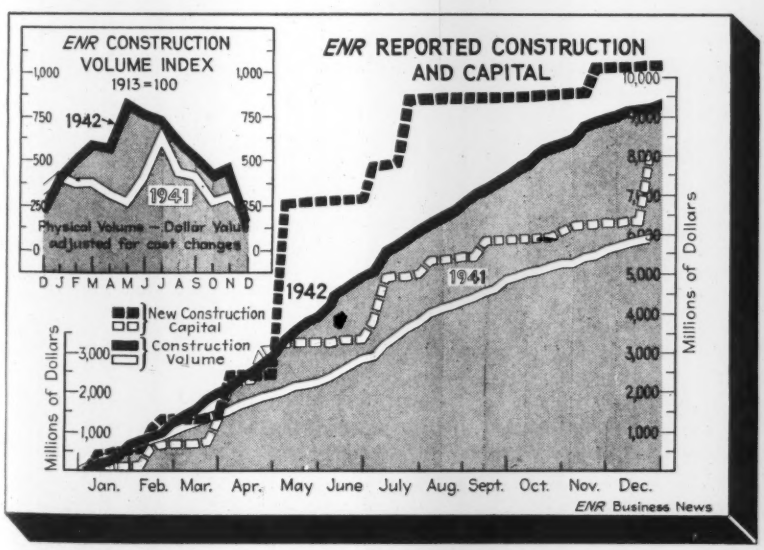
ENR INDEX NUMBERS

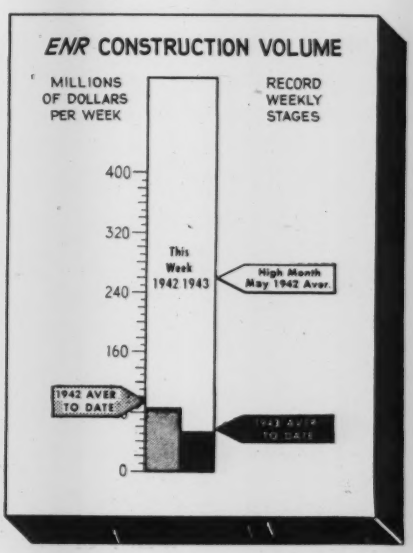
Index Base = 100	1913	1926
Construction Cost ... Jan. '43	283.45	136.25
Building Cost ... Jan. '43	226.87	122.64
Volume ... Dec. '42	227	100

FHA MORTGAGES

	Week Ending Jan. 10 1942	Jan. 2 1943	Jan. 9 1943
Selected for appraisal			
Title II	$14,023	$1,882	$2,795*
Title VI	$4,774	$3,667	$9,298*

* Subject to revision.


ENR CONSTRUCTION VOLUME INDEX
1913=100
1942
1941
Physical Volume — Dollar Value adjusted for cost changes
D J F M A M J J A S O N D
ENR REPORTED CONSTRUCTION AND CAPITAL
New Construction Capital
Construction Volume
Millions of Dollars
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
ENR Business News


ENR CONSTRUCTION VOLUME
MILLIONS OF DOLLARS PER WEEK
RECORD WEEKLY STAGES
This Week 1942 1943
High Month May 1942 Aver.
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Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

AN EVALUATION OF WPA

Sir—The liquidation of WPA was the subject of an editorial in the *Engineering News-Record* of December 17, 1942. The opinions expressed in that editorial were not favorable to the organization nor to its methods. You are fully entitled to your opinion, and I support your right to express it. However, since I was selected as representative of a group judged separately, I feel called upon to offer my comment. I could not do otherwise and retain the right to your commendation.

It would be quite possible to answer the statement of unfavorable opinion by an informed statement setting forth in glowing terms opinions, just as positive, extolling the WPA for its virtues, its economies and accomplishments. It would be equally possible to express opinions regarding my own part just as unkind as yours were charitable. I do not wish in this instance to enter such a debate. What I do wish to point out are facts that in fairness should be stated for the benefit of your readers and to offer a few of my own opinions which I believe are relevant and constructive rather than blindly or bitterly prejudiced.

A democratic operation

The actual operation of the Works Projects Administration has been democratic in that it was of the people, by the people, and for the people. Its size and scope and thorough decentralization took care of that. The eight million workers who have been on the payrolls make up so large a section of the population, that to characterize them as wasteful, or selfish, or in any other disparaging terms would be just as unwise and inappropriate as it would be to use the same terms with respect to our armed forces. Their over-all characteristics were those of Americans, and it is generally agreed Americans can be rated as entirely competent and dependable when it comes to such expressions of a self-governing people.

The selection of this personnel was not the work of a small political clique or organized lobby in Washington. Their neighbors and fellow townsmen in every corner of the nation determined who should have the right to work. The projects on which they worked were likewise selected locally from among those designed by local engineers and architects and offered by local officials. The motives of these sponsors and their honesty and judgment as to the selection of projects cannot be condemned in general terms without covering the continent in a blanket indictment of its local leaders. The benefits of WPA projects were general and for the public good, whether from wages or the enjoyment of the facilities provided. These could not properly be called wasted. The meager wages could not be hoarded—that money flowed promptly into the local commercial channels and helped to avert a national disaster. If we must center our attention on possible money waste, that fact cannot be overlooked. In all these things WPA was as democratic, as American, as our public school system.

The mechanism for determining the supervision of that part of the work concerned with construction appears to have been your principal concern since that was not the competitive bidding usually used on public works construction. When a specified structure at the least cost is desired, that method, with all its well-known weaknesses, is accepted as generally being the best so far devised. It transfers risk and responsibility, usually to competent and honest contractors, in return for a possible profit. However, it does not follow that the contract method is the best way to insure the most able supervision when the work opportunities for specific persons are primary ends and engineering structures are by-products. The persons who had gained their skill as supervisors of construction on contract operations were quite generally employed to supervise WPA construction, but they were not chosen because they offered their talents at the lowest price. They formed the backbone and bulk of the WPA supervisory staff and to change the method of their selection would afford no assurance they would do in better shape the job they had to do. Neither is there any assurance that the extension of the contract method of selecting supervision would insure more competent supervisors for the multitudes of projects other than construction.

The contract system is a great American institution, and I am proud of the record that many of my friends have made in that field. I hope they continue to prosper. I have endeavored with some success to increase appropriate participation of skilled contractors in WPA work, but the final solution to the problem is not an easy off-hand transfer of all such work to the contract method.

A new basis for efficiency

The principle of the right to work has been established. The techniques by which that is implemented are still capable of great improvement. In effectuating this principle man-hours of suitable work opportunities must have definitely determined priorities over mass per dollar of physical accomplishment. Accordingly, a new basis for determining efficiency must be established and recognized so real waste will be discoverable and reputable people will not fall into the same error that characterized your editorial. This all constitutes a new type of engineering that goes far outside the field of public works construction, far beyond the narrow concept of your editorial. Leaders in the field of private enterprise should recognize this and prepare for the demands that will surely emerge after the war is won.

The earnest study of such problems has been one of the major concerns of the WPA, and the continuation of that study by every one is next in importance to winning the war. We shall need further improvements in policies and procedures and techniques even over those WPA has accomplished. Whatever the form of the administration that takes the place of WPA when the need again arises, that administration should be given the benefit of all the constructive findings that are bound to flow from such a study. These added to the experience record of WPA will permit

the creation of a program of even greater accomplishment and of even higher integrity.

There are many capable people with first hand practical experience in this wider field of engineering. Only a few are still with WPA. All are equipped to give valuable advice. Their opinions will vary as their experiences have differed. But evaluated and integrated they will afford the only sure guide for advance.

It is only in the light of such an interested but impartial study that further work programs, when needed, should be prosecuted. That is the only light by which WPA can be honestly and fairly judged. Such constructive examination will be slow of accomplishment, but I believe it will be had. In the meantime, if judgment must be passed, I hope to be judged, as I stand, with my millions of fellow Americans in and of the WPA rather than apart from them, for I believe in them, in what they have accomplished, and in what they still will do.

PERRY A. FELLOWS
Assistant Commissioner
Chief Engineer
Work Projects Administration

Sir:—The writer has read the editorial "The End of WPA" which appeared in your Dec. 17 issue.

The editorial is worthy of the *Engineering News-Record*. From 1930 to 1933, the country waited in expectation of the development of a plan by industry, in general, and in particular by the construction industry, that would provide employment for the millions of unemployed for whom no work could be found in the manufacture of goods on work that would be useful to the nation. It waited in vain. During this period the contribution of the *Engineering News-Record* was a special page in each issue filled with homilies and platitudes.

It is fortunate that the country had a President big enough and human enough to turn his attention to the development of a constructive plan and tough enough to stand the criticisms of the construction industry, which regarded the construction of public works and the hiring of labor as a vested interest of the contractors associations and equipment manufacturers. The engineers who took over the responsibility of executing the plan in the 48 States were experienced in all forms of construction and by no means unknown to the engineering profession. They were inspired by the leadership of the President and the objective sought to be accomplished. This inspiration enabled them to resist the efforts of exploitation of the plan by selfish interests, to insist upon high engineering standards and construction practices in the plans of the sponsors of work programs and to institute training methods to produce efficient construction forces from the untrained labor available.

The general charge in your editorial of waste and inefficiency is not sustained in the hundreds of letters that have been written and public testimonials that have been made by high ranking Army and Navy officers and by responsible mayors of cities which have been benefited in their financial stress by the assistance furnished by the Work Projects Administration in creating useful public works by force account methods. As a matter of fact, it is the work started in 1935 by the Work Projects Administration, which not only conserved the rapidly disintegrating manpower but saved the construction industry from taking a nose-dive into bankruptcy. There has been no appreciation of this fact evidenced in your paper, which has nominated itself as the spokesman for the construction industry. To the contrary, in all the years of operations of the WPA there has never been anything but sneers and vituperation directed against the WPA and its administrative personnel culminating now in the cheap paraphrase of the initials of the WPA in forming the expression "waste passes away".

The WPA has no apologies to make for its existence as a national measure nor for the manner in which it has performed its duties definitely outlined by elected representatives of the people who did not see fit to agree with the theory of the *Engineering News-Record* that construction of their own public works was a private interest preserve. They have shown that the labor and the engineering brains of this country are possessed of the inherent ability to do its own work in its own way whenever it finds it necessary.

As to the future it may be well for the *Engineering News-Record*, and those for whom it asserts the right to speak, to ponder the words of Theodore Roosevelt when approached to show a special favor to a private interest: "We believe that this country will not be a permanently good place for any of us to live in unless we make it a reasonably good place for all of us to live in."

JOHN P. HALLIHAN
Director, Municipal Engineering Section
Work Projects Administration

(EDITOR'S NOTE—In subsequent correspondence Mr. Hallihan suggests that a fitting headline for these letters might be "The Corpse Sat Up and Talked." Not only is it appropriate, but it describes a result that it was hoped the editorial would produce. Work relief is a question that must be talked about—and thought about—by everyone who wants America to grow and prosper.

Mr. Fellows' reasoned letter, which reflects some of this thinking, is discussed on the editorial pages of this issue. Both he and Mr. Hallihan, however, misread the editorial on two different points—that it criticized WPA personnel, design and administration, and that it turned thumbs down on all force account construction. On the contrary, it specifically emphasized the "exceptionally capable and honest performance of many of its administrators and engineers," and it spoke only of the difficulty of achieving efficiency on force account on a nationwide scale "in dozens of states and thousands of towns."

The editorial maintained that the WPA philosophy of work relief—of using the construction function as a device to make subsistence-wage jobs—was inherently wasteful. The fact that some such procedure may have been necessary in the extreme depression emergency in which we were caught merely emphasizes the challenge to find something better. Unless we can, we are merely drawing the blueprint of a poverty-stricken and decadent nation.)

Youghiogheny Contractors

Sir: In *Engineering News-Record*, Dec. 3, 1942, p. 777, giving a description of the Youghiogheny Dam at Confluence, Pa., you list The Hunkin-Conkey Construction Co., Cleveland, Ohio, as being the general contractor. This is an error, as the contract is held jointly by the Hunkin-Conkey firm and Shofner, Gordon & Hinman of Los Angeles, Calif.

FLOYD SHOFNER
Shofner, Gordon & Hinman, General Contractors, Los Angeles, Calif.

EDITORIALS

VOLUME 130 NUMBER 2

January 14, 1943

Roads Must Be Maintained

THE SERIOUSNESS of the situation in which state highway departments find themselves is told by Thomas H. MacDonald, head of the Public Roads Administration in a statement appearing as part of a special section of this issue given over in large part to discussion of highway maintenance problems. Mr. MacDonald's statement warrants the thoughtful consideration of all who wish to keep informed on current engineering problems.

Curtailment of new highway construction has increased the maintenance operations of the highway departments by making impossible replacement of old roads that are rapidly going to pieces under the increased load of war traffic. Nor have the restrictions on tire and gasoline use brought any relief, for while private automobile traffic has fallen off, truck traffic has increased and the average load per truck has been raised, thus accelerating the rate of wear on highways. Maintenance operations, on the other hand, are made more difficult by loss of men to the armed forces or to war industries and by inability to get replacements for worn-out equipment or spare parts for current repairs.

Financial problems add complications to these physical ones. Income from gas taxes and motor-vehicle fees have declined sharply, and probably will fall off more this year. In some states this decline is not serious, but it is serious for states having high fixed charges for bonded debt or for those states where fixed amounts must be turned over to counties or other states subdivisions for their road work. Diversion of road funds to other than road purposes adds a further complication in some states. Demands for more diversions may be expected this year.

These conditions call for prompt correction if our highways are to be kept in condition to carry the load that the war may put on them for an indefinite period. The War Production Board will have to ease restrictions on repair parts and replacements for road maintenance equipment, and the legislatures of many states will have to revise the system by which road maintenance is financed. But little can be expected along this line until the public is aroused to the seriousness of the situation. It is here that the individuals in the construction industry can do their part. Without servicable highways our whole economic system will be slowed down and our war effort handicapped seriously.

Unspinning Technique

CREDIT IS DUE those in charge of dismantling the wrecked Tacoma Narrows Bridge for ingenuity in improvising equipment. With little precedent as a guide and without the aid of priorities, effective equipment has been designed, assembled from such materials as could be had and has been successfully removing 100 tons of main cable strands for each 8-hr. shift of the unspinning crews. Thus, in its last days, two years after the spectacular collapse of the floor system in the 2,800-ft. span, this structure contributes another item of information—this time on unspinning technique, a reversal of the process of assembling the strands. The Tacoma Narrows Bridge may go down in history as a structure from which more was learned than from any other bridge ever built. Not only the design of a new bridge for this location, but also the strengthening of existing structures and the future planning of all long suspension bridges, wherever they may be, will be influenced by the lessons learned on this bridge. In short, this collapse may become the most important incident in the history of bridge building. Certainly it is highly unlikely that there will be any competitors from the standpoint of the amount of information that it has contributed to the science of suspension-bridge design.

Smoother Pavements

ONE OF THE CURIOUS changes that the war has brought is a recommendation that the non-skid qualities of pavements be reduced as a means for saving wear on tires. Heretofore, the efforts of highway builders have been centered on giving pavements non-skid surfaces. Studies made for the Highway Research Board by the engineering staff at Iowa State College show that pavement roughness is a major factor in tire wear and that the rate rises sharply as speeds go above 40 mph. As a result, Prof. R. A. Moyer, head of the pavement roughness study, recommended to the Highway Research Board that as an emergency measure. pavements having a rough surface be given a seal to reduce abrasive qualities, keeping the amount just below that which might produce a slippery surface (see p. 70). This recommendation might be considered too radical for safety were it not for the war-time speed limit of 35 mph. that now controls all traffic moving on our highways. So long

as that speed limit is observed, the danger of skidding on highways is greatly reduced. Nevertheless, if the 35-mph. speed limit is strictly observed, pavement roughness becomes a less important factor in tire wear. Hence, unless the synthetic rubber program cannot be expected to bring some measure of relief for many months, a wise precaution would appear to be to limit sealcoating to only the most abrasive types of surface.

Good as Well as Fast

DESPITE THE SPEEDY TEMPO and pressure of wartime needs, much thought and conscientious planning have been applied to the design of the new wartime structures and facilities that are being built, many of which are simply for temporary use. A case in point is the sewage disposal plant for an army camp, described elsewhere in this issue. Every sanitary engineer will recognize that this project gives expression to the most recent developments in the art of sewage disposal and includes, as well, nice attention to practical details. All this bespeaks work of the highest professional competence, and pays a rich compliment to the designing engineer and his staff. Similar statements may be made for a host of war projects that stand distinguished by excellence of functional and structural design as well as by speed of construction.

A Choice to Make

A LETTER that is worth anyone's time to read appears in the "Comment and Discussion" pages of this issue. Written by Perry A. Fellows, chief engineer of the WPA, as a rejoinder to an editorial concerning the WPA published in these pages in the December 17 issue, it is the fairest and most thought-provoking presentation of the work-relief theory as applied to construction that has appeared in many a day.

The philosophy of WPA as set forth by Mr. Fellows is summed up in these two statements: "Work opportunities for specific persons are primary ends and engineering structures are by-products," and "Man-hours of work opportunities must have definitely determined priorities over mass per dollar of physical accomplishment."

It was against this philosophy of WPA, not its administration, its personnel or its choice of projects that our editorial statement of December 17 was directed. Despite the notable performance of thousands of administrators, the cards were stacked against them because the system was inherently wasteful.

Nor did the editorial make a point of approving contract construction as against force account operations, as Mr. Fellows implies. It ventured the opinion that any attempt to use force-account methods wholesale on a national scale is wasteful. There is basis for such a statement in comparing the history of force-account and contract methods, and yet there are important exceptions, such as the TVA construction operations. But the scale and variety of the TVA operations is in no way comparable with those of the WPA.

The important questions posed by Mr. Fellows for civil engineers and construction men in the work-relief philosophy that he sets forth are whether in an emergency like that of the early Thirties there is no alternative to accepting the use of construction as a means for supplying a mere subsistence-wage job for everyone needing a job, be he bank clerk, salesman or garment worker; and whether efficiency of construction, as measured by cost and speed, should be merely a secondary consideration. These questions also are of importance to cities, states and the federal government, who are the purchasers of public-works construction.

There are those who accept these conditions, believing that only thus can unemployment be averted. We shun such a conclusion, first, because such a system tends to perpetuate itself and expand to cover all public construction, thus sentencing millions of persons to working indefinitely on a subsistence level in jobs for which they have neither talent nor liking, and, second, because it takes from construction much of the incentive that has attracted able men into its service in the past.

What is the answer to unemployment relief we do not profess to know, but civil engineers and construction men have a vital stake in determining that it be an improvement over the work-relief philosophy that motivated the WPA. Certainly, a nation that is on the threshold of planning a post-war world should not begin by resigning itself to the inevitability of such a philosophy. Nor is it realistic to start out with the assumption that the whole load of unemployment relief should be carried by the construction industry. The study that Mr. Fellows urges should be made by the best brains that this nation has available.

ENGINEERING NEWS-RECORD WALDO G. BOWMAN, *Editor*
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Fig. 1. Because of outcropping rock excavation for this large reinforced concrete pipe required extensive blasting.

Airport Drainage on a Rocky Site

***Contents in Brief**—Because many trenches for pipe had to be blasted through rock, construction of the drainage system was one of the major problems in building an airbase. For this phase of the work nearly 50,000 cu.yd. of rock were removed with the average dynamite consumption about 3 lb. per cu.yd. Over 40,000 lin. ft. of concrete pipe varying in size from 12 to 108 in. and 33,400 lin. ft. of 6-in. dia. vitrified clay pipe were installed.*

REQUIRING REMOVAL of 50,000 cu. yd. of rock, construction of the drainage system for a big airbase in the south was one of the most difficult problems experienced on the project. The field is located on a relatively flat site but extensive out-cropping rock, mostly limestone, was encountered and required blasting for removal.

The drainage system, which cost $1,000,000, was designed for the removal of a 2-in. rainfall in four hours. A run-off of about 75 percent could be expected, since nearly 1,000,000 sq.yd. of the large area comprising the actual flying field was paved to form the runways, taxiways, and the apron. The remaining area was sodded. The drainage system is designed to provide for future enlargement of the field if dual runways are constructed.

Drainage operations consisted of four major parts. First, grading the field to form a series of valleys roughly paralleling the runways; second, installation of a pipe collection or main drainage system with manholes and catchbasins; third, construction of a sub-drainage system along the edges of the paved areas and connecting these drains to the main drainage system; and fourth, building a box drain to intercept the runoff from the large paved areas of the apron.

Most costly was the interceptor network of concrete pipes, shown in Fig. 3, which also shows the general layout of the field. All of the discharge from this network is concentrated in two large outfalls, one of 108 in. dia. and one of 78 in. Nearly 2,000 ft. of the 108-in. pipe was used, and in all, the field required over 40,000 lin. ft. of concrete pipe, varying in diameter from 12 to 108 in.

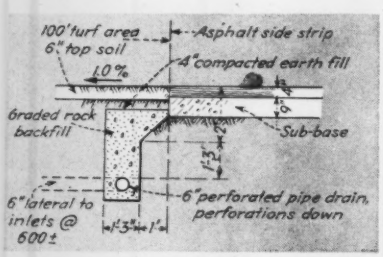


Fig. 2. Along each edge of all runways drains of the above type were required. These drains were connected to the sub-surface piping system, shown in Fig. 3 by 6-in. dia. virtified pipes on about 600-ft.

For the side drains along each edge of all runways a 6-in. dia. perforated vitrified clay pipe was installed as indicated by Fig. 2. These drains totaled 27,000 lin. ft. An additional 6,400 lin. ft. of 6-in. dia. non-perforated clay pipe was used for connections about every 600 ft. between the side drains and the concrete pipe collecting system. The connecting lines joined the larger pipe at a combination manhole and catchbasin. In all nearly a hundred manholes were built and all of these were equipped with cast-iron grating covers.

Along the centerline of the three 300-ft. wide concrete slabs that join to make the triangular apron reinforced-concrete box drains of 3-ft. wide concrete are set at varying depths. In all, 6,500 ft. of this box construction was used. The low points of the drain are connected by pipe to the main collecting system. The slab or top of the box, which has 2-in. transverse slots spaced on 14-in. cen-

ters, is 14-in. thick; the sidewalls and the bottom are 8-in. thick.

Because it was the most difficult part of the drainage work, construction of the interceptor network of large pipe will be described first. This work started at the same time as the grading of the field. Where the overburden was sufficiently deep to permit their use, trenching machines were used for cutting the necessary trenches. Rock in various stages of weathering was encountered and few of the mains were installed without some blasting being necessary. On an average, about 3 lb. of dynamite per cu. yd. of excavated rock was used, but the quantity varied greatly as to whether ledge rock or a honeycombed formation was encountered; greatest depth of excavation was 15 ft.

Drilling was done by jackhammers and wagon drills; and at capacity operation 4 wagon drills and 60 jackhammers were used. In narrow trenches the jackhammers were used for drilling a single line of holes on about 6-ft. centers. For the wider trenches more holes were required and three lines were often used. To reduce the amount of reshooting required, the holes were drilled to a somewhat greater depth than that required for the grade of the trench. The loosened rock was removed by draglines and shovels.

Large pipe reinforced

For the interceptors, concrete pipe was used and for diameters larger than 15 in. it was reinforced. The 6-in. pipe was produced about 30 miles from the job and the 72 to 108-in. dia. pipe were manufactured at a plant about 5 miles from the project. A major reason for casting the pipe at central plants was the greater protection possible against cold weather during the manufacturing operations than would have been possible for concrete work performed in the field. All pipe was delivered by truck and the sections of the large sizes were loaded and unloaded by crane.

The most satisfactory hitch for shifting the larger pipe from the bank to the trench with the crane proved to be a 3-in. dia. eye bolt with threaded end. The bolt was run through a hole cast into the pipe at about the center of gravity of the section and on through an 8 x 8-in. timber extending longitudinally through the pipe; the timber was of the same length as the pipe sections

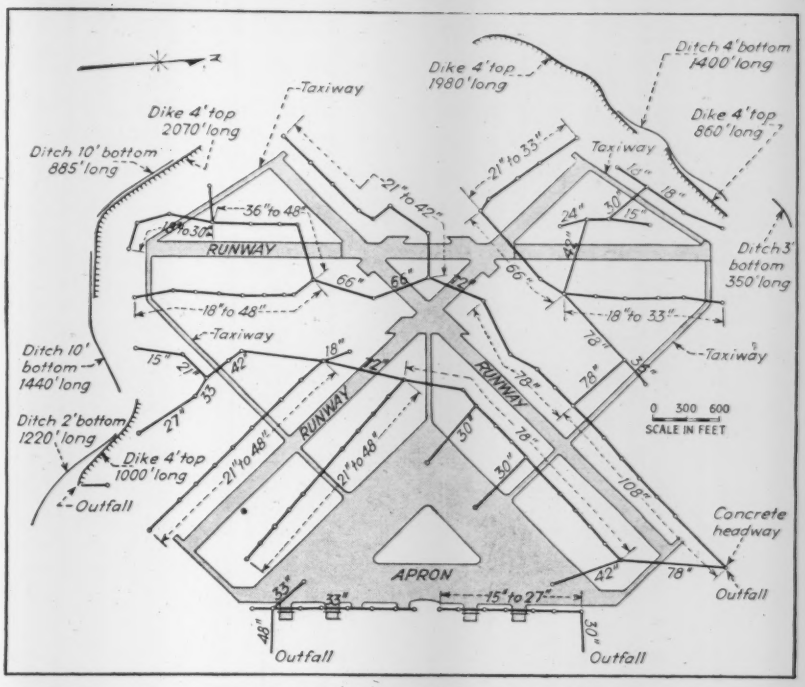


Fig. 3. General plan of the field showing the layout of the concrete interceptor mains, which consisted of 40,000 ft. of pipe varying in diameter from 12 to 108 in. Not shown are the side drains along each edge of all runways, which required 33,400 ft. of 6-in. clay pipe, including connections to interceptors.

Fig. 4. Where the trenches for the concrete interceptors were cut through rock a gravel cushion was added before the pipe sections were installed.

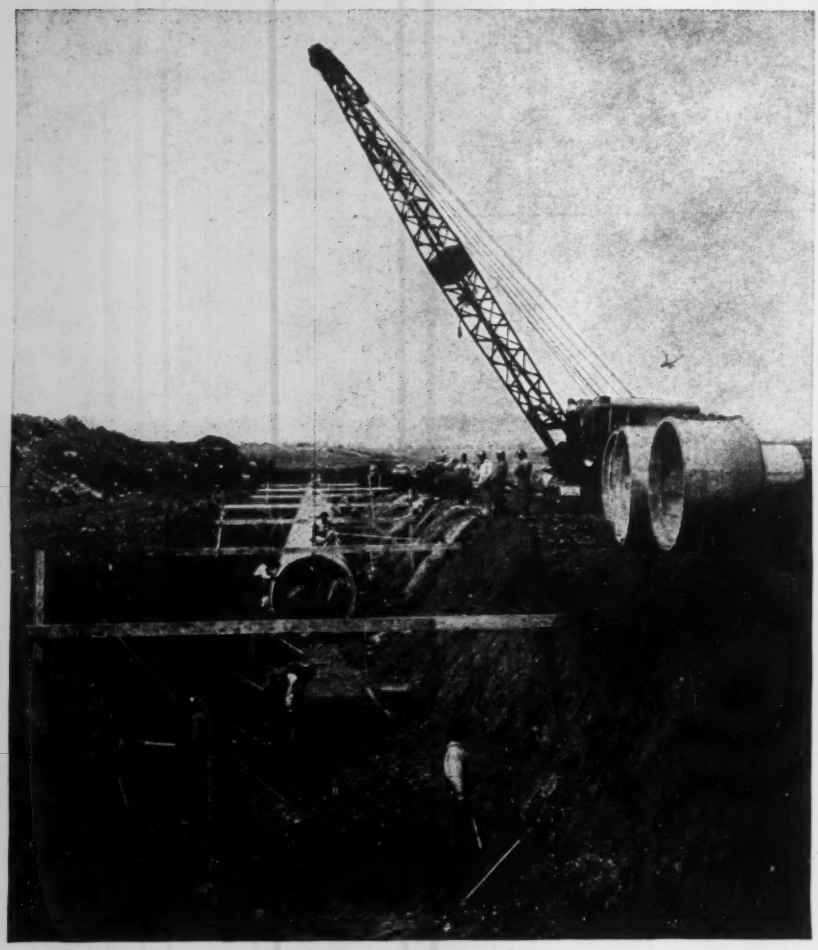


Fig. 5. Crawler cranes were used to lower the larger sections of pipe into place after the bottom of the trenches had been leveled with hand labor.

Fig. 6. Backfill was added in thin layers and hand tamped until the pipe was covered, then bulldozers operating in the trenches spread and compacted the material.

being handled. Washers and nuts completed the fastening. After the pipe section was in place and the eyebolt removed, the hole in the top of the pipe was plugged with concrete.

The smaller size pipe was loaded by rolling the sections onto a platform and from the platform onto the trucks. For placing the smaller pipe sections the common steel "U" was used, one arm sliding into the pipe and the crane hitch being attached to the other.

Before placing the pipe in the trenches excavated in rock, a gravel bed varying in depth and width was added in the bottom of the excavation. Since all the pipe had tongue and groove joints, no joint packing was necessary, but all joints were cemented.

Backfilling around the interceptor mains consisted of common earth, which was placed in 6-in. layers and hand-tamped until at least a 2-ft. covering over the pipe had been secured. The remaining material was spread and compacted by small bulldozers operating in the trench.

Drains built as field is paved

The 6-in. side drains along each edge of all runways were built in conjunction with the runway paving. The trenches were generally prepared by trenching machines and averaged about 3 ft. in depth and 1½ ft. in width. A 6-in. layer of graded rock backfill for bedding the pipe was added. The pipe of vitrified clay, bell and spigot type, was perforated for about one-third of its perimeter and the sections were laid with perforations down.

Crushed stone backfill graded to act as a filter was spread by hand in thin layers and hand-tamped until the pipe was covered. Then blade graders operating on the completed runway pavement slab spread the remainder of the crushed stone, which was dumped directly from the trucks into the trenches until brought up slightly above the level of the adjoining base course. Compaction of the remaining fill was by mechanical equipment.

Construction of the 3-ft. wide reinforced concrete box drains along the centerline of the triangular shaped slab forming the apron was also done while the field was being graded.

Location of the airbase cannot be given, nor can those in charge be mentioned.

Multiple-Arch Concrete Roof Saves Steel

***Contents in Brief**—Design of one of the nation's largest war plants was changed from structural steel to concrete frame and multiple-arch thin-slab concrete roof when steel was banned for such projects. The adopted design requires only 2.7 lb. of steel per sq. ft. of floor area. About one-fourth of building is air conditioned, remainder is fan ventilated.*

AMONG A NUMBER of new war plants that have been built for the Chrysler Corp., one in particular is notable for its contribution toward saving steel. By the use of a special type of reinforced concrete framing, only 2.7 lb. of steel per sq.ft. of floor area was required, whereas an original design in structural steel had called for 12.7 lb. And because the plant is said to be the largest in the country, the main building of the 19 building layout covering over 80 acres, the total steel saving is measured in thousands of tons.

The framing is characterized by multiple thin-section arch slabs spanning 38 ft. between concrete girders, which in turn, are supported by concrete columns every 30 ft. Uniformly 3 in. thick except at the edges where they meet the girders, the arch slabs are built to a uniform radius of 46 ft. 10½ in., which gives them a rise of 4 ft. They are reinforced with only a single layer of 4x4-in. No. 6 woven wire mesh, wherein rests the reason for the great economy in steel.

Each 30-ft. length of arch roof is stiffened by concrete ribs, 5¾ in. wide and of uniform thickness, located at the column lines and at the center of each bay. These ribs, placed under the arch, are solid except for four oval-shaped holes, 10-in. maximum width and 22-in. high, for passage of piping. The holes, smaller at the bottom, are designed to receive wooden wedges that support the pipes. In addition there are six 1-in. pipe sleeves through each rib, just above the bottom steel, to serve as hangar inserts. Slabs and ribs frame into the girders, 18 in. wide and 27 in. deep. Columns supporting the girders are 18 in. square and are haunched for 5 ft. on the two sides beneath the girders.

The roof framing is designed for a live load of 25 lb. and a dead load of 75 lb. per sq.ft. The arch ribs are also designed to carry two 500-lb. trolleys per bay. Details of slabs, ribs and girders are shown in the accompanying drawings.

All bays are similar except for special roof curbs and thickened slabs supporting various pent houses, and except for a section over a heat treatment pit, where wider spans were desired. Here, for a length of 465 ft. along one side of the building, the two outside arched roof bays have been replaced with one arch span of 63 ft. 4 in. and a flat slab span of 12 ft. 8 in., with corresponding changes in column spacing. For the wider span the arch slab is increased to 4 in. thickness, and has a rise of 7 ft. 3 in. The stiffening ribs are increased to 9 in. thickness, and have open instead of solid webs.

Expansion and construction joints

Naturally in such a vast roof, expansion is a problem. This is taken care of by cutting the structure completely by two longitudinal and four transverse joints. The longitudinal joints consist of split columns and girders, with high curbs over the girders to carry the roof expansion detail. In the transverse direction the joints are at mid-bay points, with the girders cantilevered from adjacent bays. At these joints also, high curbs on the arch slab carry the roof detail.

The expansion joints themselves consist of wood blocks and strips anchored to the high curbs and covered with reinforced asbestos flashing. A protecting fin is made up of two sheets of 3-ply asbestos roofing. At the wall line, between double columns, the vertical expansion joint consists of a V-shaped assembly of the same asbestos roofing, held at the

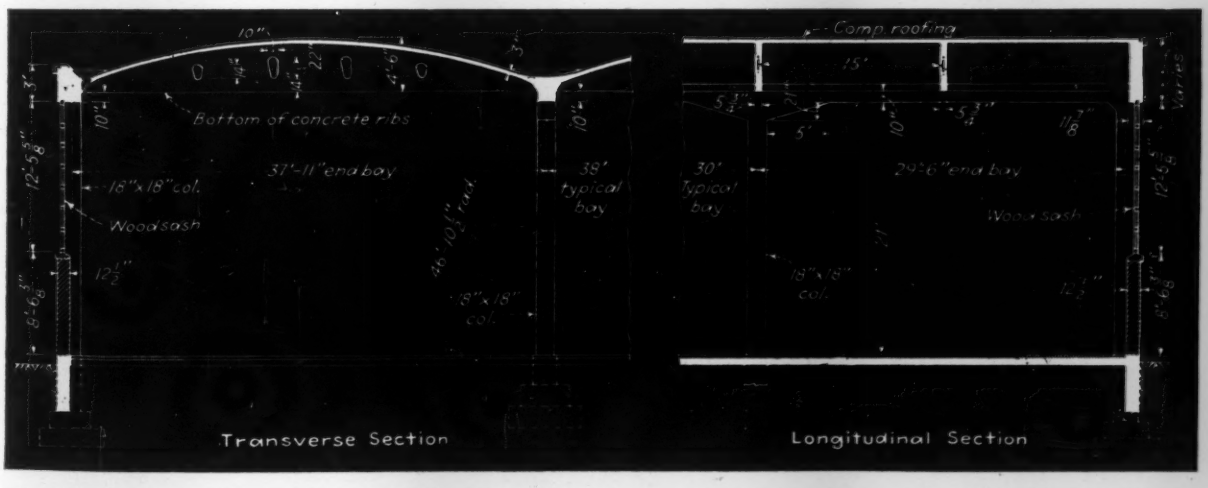


Fig. 1. Repeated many times, these typical bays of concrete framing effect a tremendous saving of steel for use in essential war machines and armament.

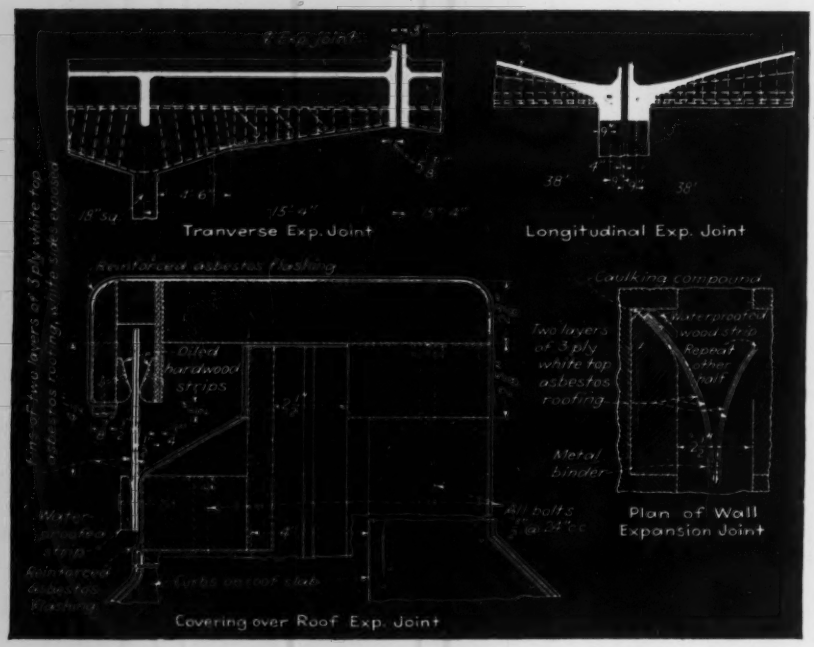

Tranverse Exp. Joint
Longitudinal Exp. Joint
Caulking compound
Two layers of 3 ply white top asbestos roofing
Metal binder
Plan of Wall Expansion Joint
Covering over Roof Exp. Joint

Fig. 2. Expansion joint details. Two longitudinal and four transverse joints divide the building into 15 sections.

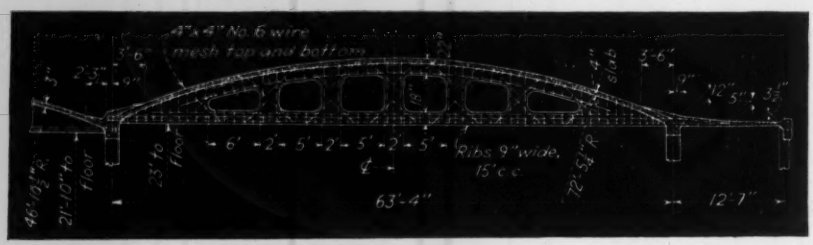


Fig. 3. Special long-span arches carry the roof over the heat-treating pit. The 63-ft. 4-in. arch span plus the 12-ft. 7-in. flat slab span occupy the same width as two 38-ft. typical arch spans.

intersecting point by a metal binder; the tips of the V are nailed to wood inserts in the columns.

Comparison with other types

The multiple arch roof was not adopted until several other designs had been investigated. In accordance with Chrysler's plan of operation, the original steel design called for 76-ft. span trusses 30 ft. apart. When lack of steel became apparent, a similar design was worked out with wood columns and trusses, but inability to obtain the large amount of connecting hardware eliminated this design.

Then the designers turned to concrete. First a flat slab, 5 in. thick at the center and 9 in. at the haunches, was worked out with 30x30-ft. bays. This scheme required 5.3 lb. of steel per sq. ft. which was considered too high. Next a lighter slab in 20x38-ft. bays was investigated, which ran about 3.5 lb. of steel, but such small bays were unsuitable for proper plant operation.

Finally the arched slab was suggested. First studies on 40x40-ft. bays showed a steel requirement of 4 lb. although subsequent refinements brought this down to 3.1 lb. Then it was found that by cutting the originally-planned 30x76-ft. structural steel bays in half, using 30x38-ft. arched concrete slabs, the use of steel would be reduced to the lowest of all figures, 2.56 lb. per sq.ft. This adopted design interfered but little with the plan of plant operations, requiring only the widening of spans over the heat treatment pit, mentioned above.

Interesting, too, is the saving in concrete. Flat slab designs ran as high as 8.46 in. of concrete per sq.ft. of floor. The 40x40-ft. arches total 6.4 in. per sq.ft. while concrete in the final design of 30x38-ft. arches amounts to only 6.03 in per sq.ft.

Except for stairways to part-basement areas, and truck and railroad shipping facilities, the entire floor of the shop and assembly building is kept free for manufacturing operations. There is no general basement, but several areas are excavated for various services. Thus, two long basements, each 88½ ft. wide, run the full length of the building, to accommodate men's and women's coats and wash rooms and two lunch rooms. A corridor runs along one side, a pipe and vent tunnel along the other side. Six fan rooms for ventilating these rooms are offset from one side, and seven sets of toilet rooms as well as other special rooms are likewise offset from the opposite side. In addition there are 15 separate, isolated basement toilet rooms, each accessible from the main floor by stairways. Ejector pits are located in some of these auxiliary rooms.

A large basement kitchen and cafeteria, with its own fan rooms and truck unloading facilities, occupies an area mid-point along one wall. A transverse basement corridor, 18½ ft. wide, runs across the building, connecting the cafeteria and the two long washroom areas.

Conventional flat slab construction is used for the basement ceilings, with columns designed to support the arch roof framework. Locating the stairs to the toilet rooms along the side of the main basement areas reduced to a minimum the number of openings in this flat slab construction.

Wall details

The exterior walls consist of brick for 8½ ft. above the floor line, where they are capped with a stone sill. Above this is a continuous band of sash, usually 12½ ft. high, flush with the outside of the columns. This sash is Kahn's "Victory" design, entirely of wood except for a few metal strips and fastenings (*ENR* May 21, 1942, p. 870). It is made up in panels 4 ft. wide, with the bottom row of panels hinged for ventilation. Cement-asbestos panels replace glass over the columns.

Above the sash at the ends of the buildings and in the ends of arch roof spans, a concrete headwall is used. It does not project above the arch slabs except at the low points. Along the sides of the building is a combination concrete eave strut and parapet, 3 ft. high, into which are framed the arch slabs, stiffening ribs and outside columns.

Part of the big shop and assembly building is airconditioned, the remainder being heated and ventilated by fans, aided by natural ventilation through the sash. For the airconditioned area, long continuous penthouses are used, built of wood frames with walls of corrugated asbestos siding. Air discharge into the factory is through holes in the roof slab. The non-airconditioned areas, on the other hand, are served by individual penthouses of similar construction, but from which discharge of the air is through continuous wood frame supply ducts running down the top of the arch crown at every third bay. The supply ducts, 4x6 ft. in section, are lined with smooth cement-asbestos sheets. Round openings through the arch slab, 22 in. dia. admit air to the main room below.

Used air, unless desired for recirculation, is discharged through separate exhaust units in the roof, fan-operated and equipped with motor-controlled louvres. Air for recirculation is returned to the penthouses through holes in the roof slab.

Basement fans that ventilate the areas below main floor level are connected with vent shafts leading to exhaust and intake chambers above roof level. Toilet rooms, all in basement areas, are fan-vented through stacks.

The various fan houses are carried on curbs built above the arch slabs, but the roof framing is so designed that the slabs carry no extra load, all of it going into the ribs and girders. In some places the slabs are thickened around vent openings.

The structural design permits $\frac{3}{4}$-in. o.d. thin wall conduits to be placed in the arch roof slabs; but all other conduits and piping must be supported through or from the ribs and girders. Pipes running down the 38-ft. aisles are supported directly from the small sleeves cast in the bottom of the ribs, or are carried on wedges in the rib openings. Pipes that are too small to span the 15 ft. between ribs may be supported by hangars from the arch slabs, but the design places a limit of 400 lb. on such loads. Pipes running parallel to the ribs are carried either on hangars from the ribs or on separate special supports spanning 15-ft. between the ribs.

Fig. 4. Penthouses for the non-air conditioned area are about 15x45 ft. in plan, and discharge into continuous supply ducts on top of roof. Penthouses for the air-conditioned area are themselves continuous, each of the nine required being 410 ft. long. They discharge air directly beneath, through holes in the roof slab.

In addition to the main building there are a number of auxiliary buildings utilizing similar framing, and one of these in particular is worthy of note. As shown in Fig. 5 it is made up of three bays, a high center bay of 50-ft. span and lower side bays of 25 ft., along one of which is a 15-ft. cantilevered canopy, also of arched construction. It will be noted that the solid web rib of the side bay arch is extended through the arch to serve as a support of this cantilever from above. One other point of in-

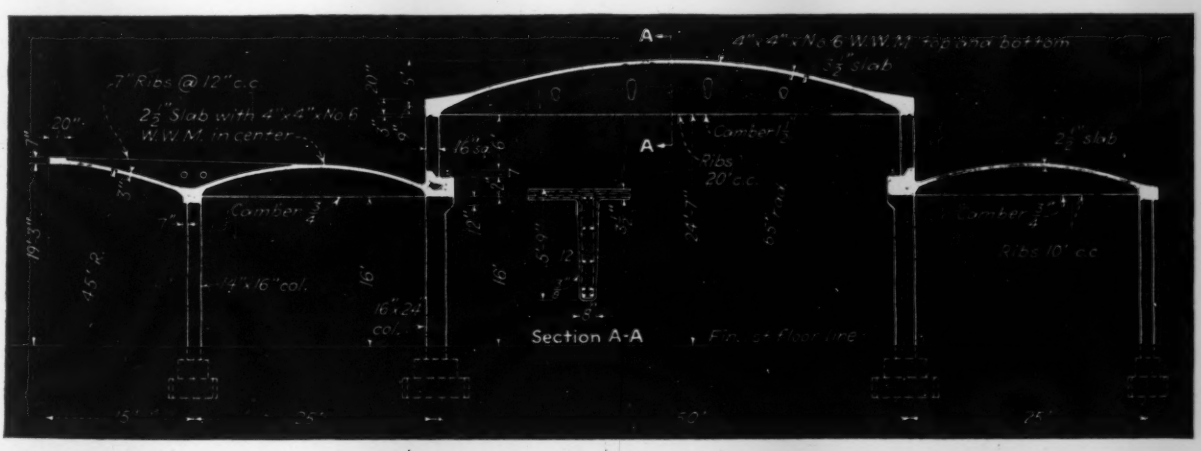


Fig. 5. Several other structures in the project are designed with variations of the arched roof used in the main building. In this one, a special feature is the cantilever canopy at the left.

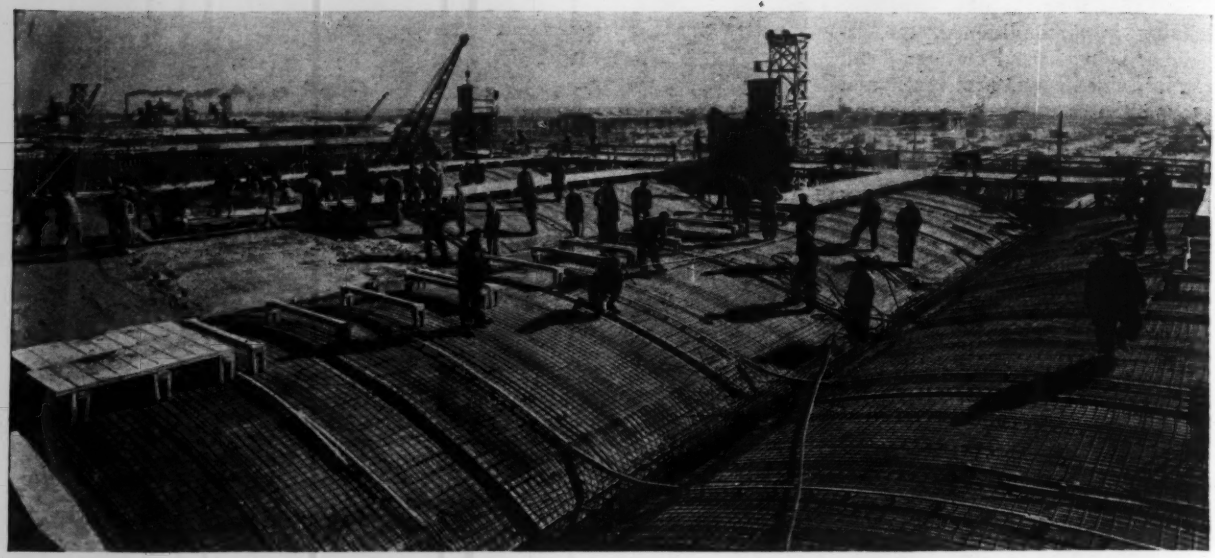


Fig. 6. Only 2.56 lb. of reinforcing is required per square foot of this building, made possible by use of light mesh in the 38-ft. span roof arches supported by columns at 30 ft. c. to c.

terest in this building relates to the crane girders in the center bay which are merely enlarged sections of the girders that support the inside edges of the side bay arches. The stiffening rib for the center bay arches also differs from other stiffening ribs in that it is of tapered section and relatively deep.

The plant is being financed by the Defense Plant Corp. K. T. Keller is president of the Chrysler Corp. and his plant engineer H. S. Wells is in charge of all construction. W. J. O'Neil is general manager and L. L. Colbert operations manager of the plant.

Albert Kahn Associated Architects and Engineers is in charge of design and construction. Charles R. Swinford is project manager on the job. The design organization that prepared the plans is headed by H. Altmiks, architectural; F. K. Boomhower, mechanical; and Harry Ellsberg, structural.

The Geo. A. Fuller Co., New York and Chicago, is general contractor, with James Murphy superintendent in charge.

Emergency 60,000-gal. Reservoir made of Wood and Four-ply Roofing

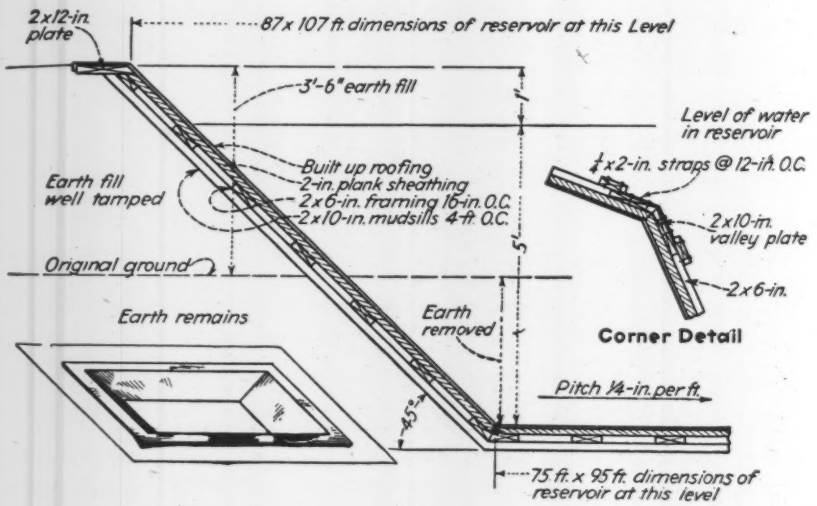
No strategic materials except nails are used in a 60,000-gal. reservoir planned for use as an emergency fire protection system near an airplane hangar with a wooden roof. The accompanying sketch tells the design story. Only one source of water is available and the reservoir is to provide standby storage in event of a water failure at the time of a fire.

Placing the structure just enough below ground line to supply material for the bank disposes economically of earthmoving. Construction requires no special skill. A commercial roofer follows normal methods in placing a four-ply, built-up roof with gravel surfaces in building the sides and bottom.

It is believed that ice, which may form on the reservoir, will be forced up the slanting sides, rather than damage the structure by expansion. Also, it is expected that such minor damage as may be caused to the waterproofing can be easily repaired by a commercial roofing contractor.

This simple reservoir may become a practical low-cost swimming pool for post war construction.

The structure was designed by Bley & Lyman, architects, Buffalo, N. Y., for use on work under the jurisdiction of the Corps of Engineers, Buffalo District, U. S. Army.



Unspinning Tacoma Narrows Bridge Cables

Chas. E. Andrew
Chief Consulting Engineer,
Washington Toll Bridge Authority

***Contents in Brief**—Equipment designed with little precedent and assembled without aid of priorities, is unspinning the main cables of the Tacoma Narrows Bridge 24 at a time—a rate that brings the total weight of wire removed to 100 tons per 8 hours. Wrapping wire was first removed on a revolving drum that encircled and traversed the main cables.*

THERE IS LITTLE PRECEDENT for unspinning the wires of suspension bridge cables and now that priorities are prerequisites to buying machinery and materials, the present is hardly a propitious time for pioneering in such an undertaking. However, the 4,000 tons of wire and a similar amount of steel in the towers of the Tacoma Narrows Bridge, which failed on Nov. 7, 1940, are no longer useful at the bridge site and are now being taken down. This steel would have to come down before the proposed new bridge could be constructed anyway and it was decided last summer to dismantle what was left of the old structure in order that the materials might be made available for the war effort. As this is being written the unspinning operations are far enough along to insure the success of the methods and equipment adopted and operated as described in the following. Failure of the Tacoma Narrows Bridge was first described in *Engineering News-Record* Nov. 14, 1940, with numerous later articles as investigations progressed.

After the roadway and stiffening girders of the 2,800-ft. central span of the bridge fell into Puget Sound, the side spans came to rest in a rather precarious condition and with the excessive sag they had, were subject to extensive movement in the wind. It was apparent soon after the failure that it would be necessary to promptly remove these side span roadways in the interests of safety. This was done in the early part of 1941 leaving only the main cables and towers remaining in place. The steel salvaged from the side spans has been disposed of as a valuable war contribution.

Design of a new superstructure, which began soon after the collapse of the old bridge, has progressed nearly to completion on a four-lane bridge instead of the former two lanes. The piers built for the original structure were not injured in the collapse and with only slight modifications they will be adequate for the proposed wider and heavier bridge.

Normally, removal of the old cables and towers would have been deferred until such time as it could have been done as part of the contract for the new bridge, particularly as costs probably would be somewhat less after the war. The need for steel in the war effort, however, made it expedient to proceed now with the dismantling even though construction of the new bridge has been postponed for the duration. The wire, which is being made immediately available for any use, is not subject to priority and is No. 6 high-strength steel with a tensile strength of 220,000 lb. per square inch.

Without precedent in the matter of equipment for unspinning and without priority for the purchase of materials or machines, the only feasible plan was to find dismantled equipment that could be rented or to make up whatever was necessary with steel that could be taken from the structure itself or purchased without benefit of priority in such places as junk yards.

The successful accomplishment of a project of this magnitude with equipment made largely from scrap and junk emphasizes the great amount of waste that has usually accompanied construction practice in this country.

To sum up, the problem was that

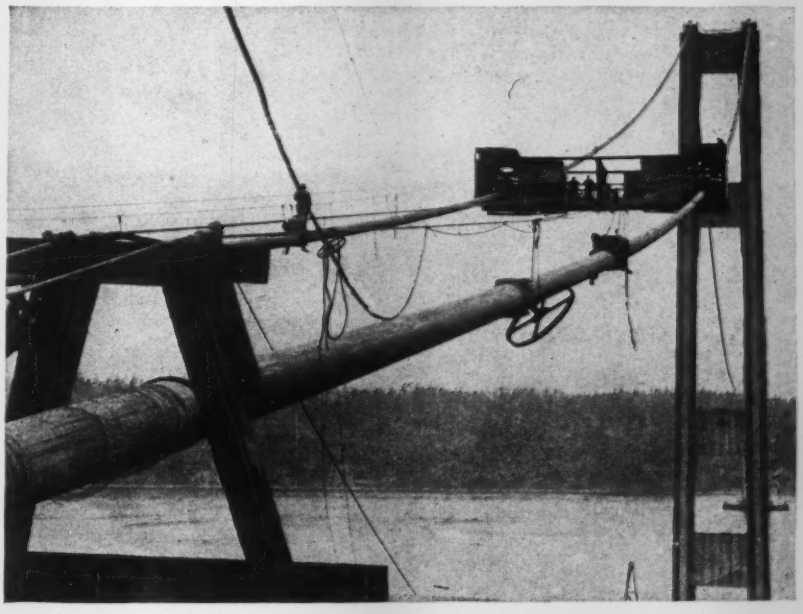


Fig. 1. One of two scaffolds used in unwinding cables. Beyond it are the "Molly Hogans," loops of wire attached to the handrails, which form a cage to confine the cable wires as they are pulled into the anchorage.

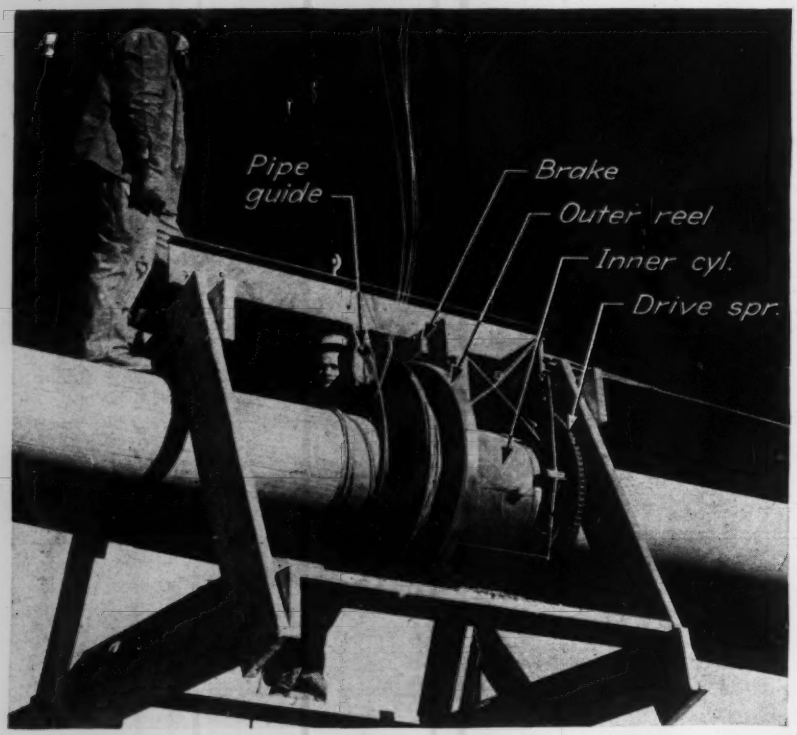


Fig. 2. Device for unwinding the wrapping wire onto a reel. The inner cylinder, rotated in contact with the cable, unwinds the wrapping wire, which is led to the outer reel through the pipe guide.

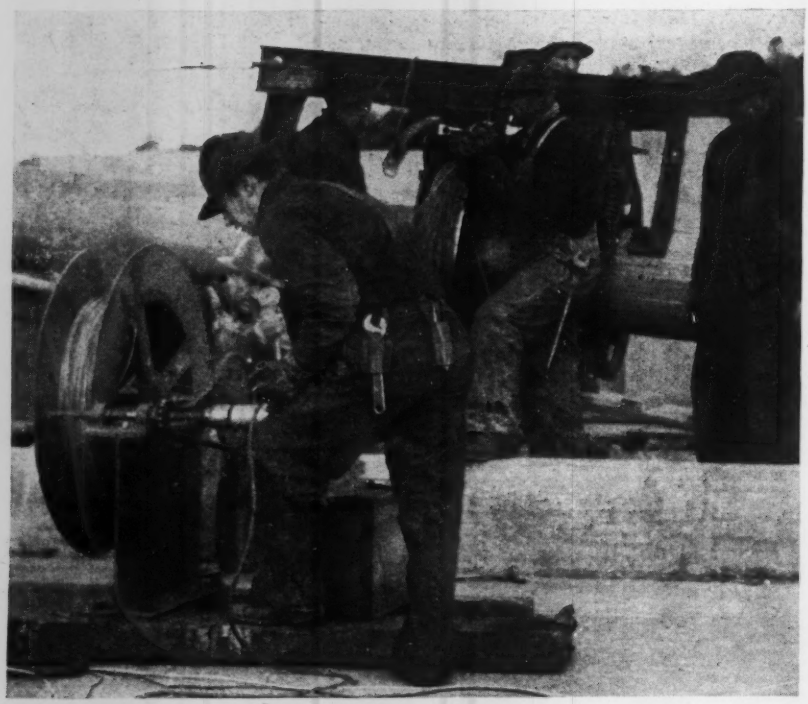


Fig. 3. Re-reeling the wrapping wire into coils with power from an electric drill. As soon as 200 lb. of wire are transferred to the reeling swift in the foreground, the left-hand flange is removed and the coil of wire seized and taken off.

of devising ways and means of saving the greatest amount of materials from cables and towers at the least cost and with the use of equipment that could be rented or could be made up with the minimum use of critical material.

One of the first decisions was that no catwalks would be built for the use of workmen engaged in taking down the cables. Removal of the cable bands and wrapping wire (which were put in place with the aid of catwalks) at first appeared to be the phase of the work that would have greatest need for this facility. However, in lieu of a catwalk it was found possible to use two scaffolds made from the bridge maintenance travellers that were salvaged after the collapse. These scaffolds, which were built to be supported on the main cables, extend across from one cable to the other, transverse to the centerline, and slide along the cables as the work progresses. In them was put the equipment with which the wrapping wire was unwound.

This wire is relatively soft and is much in demand at the present time; consequently its salvage in lengths as long as possible was important. As this wire is continuous in its wrapping between cable bands (suspenders had a horizontal spacing of 50 ft.) it is apparent how difficult and expensive it would have been to unwrap this by hand.

A simple and inexpensive unwrapping device was devised (Fig. 2) consisting of a drum or cylinder within a reel. The inner cylinder (made up of scrap steel plate) is set in a frame and rotates on small roller bearings directly in contact with the cable. The reel is rotated on the inner cylinder with motive power provided by an electric drill. Fig. 2 shows the unwrapping gear before the scaffold housing was put around it. Four of these unwrapping rigs were used, one on either end of the two scaffolds. One of the scaffolds appears in Fig. 1.

The first operation consisted of rotating the unwrapping drum against the lay of the wire and winding any desired length of wire on the reel. Tension could be put in the wire by slightly braking the reel against the speed of the drum and since the reel was larger in diameter than the drum, it revolved at a lesser speed. The wrapping wire was led to the reel through a curved pipe (this pipe can be seen in Figs. 2 and 3). When the

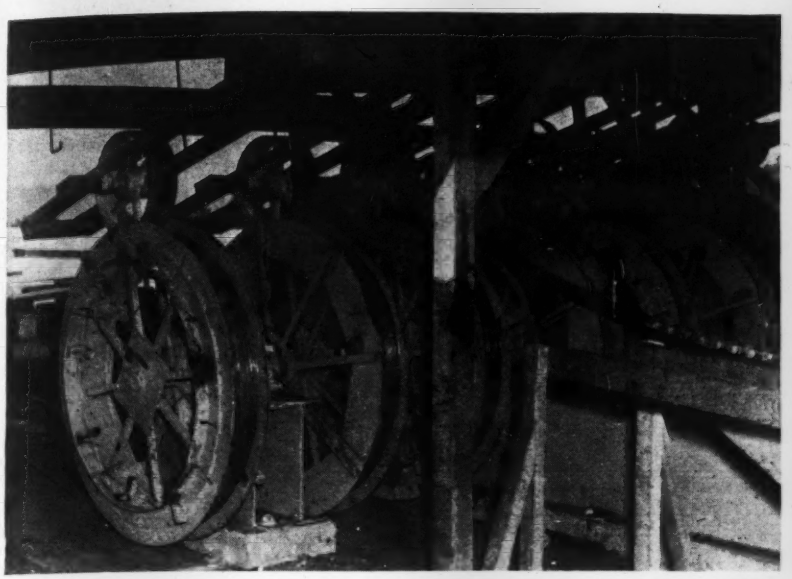


Fig. 4. Main cable reeling units. Four such sets are being used to remove 100 tons of No. 6 cable wire in 8 hr.

desired length was wound on the reel, the wire was cut and, since the reel was then free from the drum, the wire could be transferred to a collapsible swift by reversing the direction of rotation in the reel and running the wire to the swift as it unwound. For convenience in handling, the coils were made of about 200 lb. weight. As soon as this much wire was wound on the reeling swift, the removable flange was taken off and, after seizing the coil was removed, the flange replaced and the process repeated.

As this is being written, all the wrapping wire has been removed and work on removal of the main cable wire is well under way with reeling machines set up on the deck of the anchorage, as shown in Fig. 4. These machines are made almost entirely of material taken from the bridge supplemented by such items as shafting and bearings purchased in junk yards. In Fig. 4 note that spokes of the wheels are reinforcing steel and rims are welded together from steel plate scrap. Motive power is furnished by splitring motors through reduction gears formed by second-hand truck axles. Twenty-four reels are used in four sets of six each.

The process of removing the wire is to cut it at each strand shoe, fasten one end to the reel and pull it over the tower top. The wires are taken off in the exact reverse order used in the original spinning. Communications between workmen on the opposite ends of the bridge, particularly for identification of wires, as connection is being made at the reels, is made possible by the use of short wave radios loaned by the State Forestry Department.

As the reels are set up in four units of six reels each at the east anchorage, 24 wires can be taken off simultaneously. In traveling toward the wheels, the strands are held in place by wire loops loosely encircling the main body of the cable at intervals of about 8 ft. In addition, "Molly Hogans" or U-loops of wire are placed around the main cable and attached at each end of the U to the original hand ropes about 3 ft. above the main body of the cable and about 8 ft. apart. Dollies are provided at the tower tops for the wire to run over to reduce friction.

The reels are constructed so that one flange can be readily removed, thus permitting the coil of wire, which weighs about 600 lb., to be secured by seizing and taken off. The flange can then be replaced and the reeling in operation repeated. At this writing the removal of the main cables is well under way and with only a little further training and coordination of the crews, it is expected that it will be possible to remove 100 tons of wire per 8 hours.

After the cables are completely unspun, work will proceed on demolition of the towers using Chicago booms. These booms are of the four-angle latticed type and are designed with center sections which make it possible to vary the length of boom from 80 to 110 ft. The tower legs are utilized as masts. The foot and topping lifts are attached to the towers through specially designed brackets bolted to the towers through rivet holes after the rivets are removed.

The booms will be stepped up and down the towers one by the other. Dismantling will start with removal of the cable saddles at the top of the towers. Sections will be removed in the reverse order in which they were erected and lowered to barges alongside the piers. The heaviest piece will weigh about 42 tons. Heavy electrical hoists will be used for motive power. Sheaves for the lifting blocks have been made from the original strand shoes of the old bridge and a considerable part of the booms have been made of bridge material. Practically no new material has gone into the booms.

The demolition is being done under a cost-plus-a-fixed-fee contract that was awarded to Phillip Murphy & Woodworth & Co., Inc., on Aug. 21, 1942. Work started Aug. 31, 1942, and is to be completed April 1, 1943. Grover C. McLain (who was superintendent for Roebling Bros. during spinning of the cables, is superintendent on the demolition contract. The writer is in charge of the work for the State of Washington.

Standards for Adjustable Traffic Signal Heads

Standards governing purchase specifications for adjustable face traffic control signal heads have been approved and published as an American Standard by the American Standards Association. They cover such specifications as housing, doors, gasketing, traffic signal lenses, reflectors, lamp receptacles, wiring, visors, trunnions and brackets, exterior finish and method of mounting, with a supplement governing arrow lens and walk lens. The new standards were developed under the leadership of the Institute of Traffic Engineers.

These standards are available from the American Standards Association, 29 West 39th Street, New York. The price is 25 cents per copy.

High-Degree Treatment for Camp Sewage

Harry Franklin Porter
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Boston, Mass.

***Contents in Brief**—Production of a highly purified effluent coupled with flexibility to meet varying load conditions were prime requirements in designing an army sewage treatment plant. To meet these needs, as well as reduce head losses to a minimum, a two-stage bio-filtration process was employed. Among the innovations to save critical materials was the use of plywood V-notch weirs. Provisions were made to operate the plant on a partial treatment basis prior to its completion.*

LOCATION of a 20,000-man army camp on a flat site, where the only waterway for sewage disposal is a small stream, called for treatment works affording a high degree of purification with small loss-of-head. The plant designed to meet this need employs the bio-filtration process, the head loss from influent to outfall channels being only 10.31 ft.

Previous experience with a plant of similar design (*ENR* July 30, 1942, p. 173) confidently leads to the expectation that the effluent will contain not more than 35 ppm. of suspended solids and 30 ppm. of bio-chemical oxygen demand (B.O.D.), and will have a dissolved oxygen content of 50 percent. Although the contributing population will vary at times from a few thousand to the total rated capacity of the camp, the design is flexible enough to function effectively throughout this wide range, with a moderate margin of safety for possible expansion.

Of special interest at this time are the provisions adopted to minimize the use of critical materials—steel in particular. For example, the concrete clarifier walls are more massive than usual, requiring less reinforcing. And the continuous V-notched weir in all four tanks, as well as the scum baffles in the primary clarifiers, are of plywood construction. For the bio-filter enclosures, brick was used for walls. The digester construction represents advanced practice in that the load-carrying steel is pre-stressed, and this provides an economy while assuring a more watertight job.

Units were proportioned on the basis of an estimated total daily flow of 1.61 mgd., or slightly more than required by revised Army standards using 50 gal. per capita with a capacity factor of 1.5. Average flow for 12 hours was taken at 2.1 mgd., maximum at 3.45 and minimum at 0.84, with peak flow at 4.3 mgd.

The clarifiers—both the primary and secondary units—are in pairs, cross-connected (single stage), and sized for a detention of 2.5 hr. at average flow. Each tank is 65 ft. inside diameter with a side water

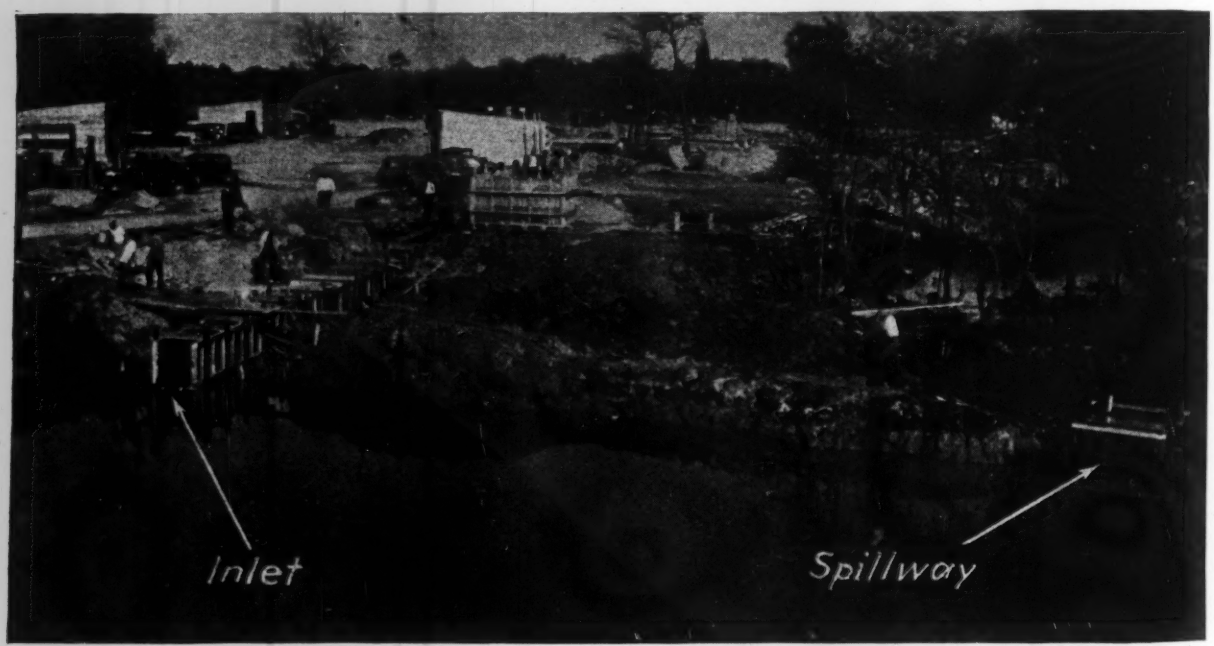


Fig. 1. Lagoon for temporary treatment. Raw sewage was by-passed around the plant, dosed with lime and then settled in the lagoon. The effluent was discharged through a spillway (shown at the right) into the receiving creek.

depth of 8 ft. increasing to 10.5 ft. at the center, with a sludge pocket at the center of 3 ft. depth.

Sludge from the primary clarifiers will be pumped into a pair of domed digesters not interconnected except through the pumps. The finer, more watery sludge from the secondary clarifiers will be returned through centrifugal pumps to the initial diversion chamber (DC-1) and so pass through the primary clarifiers a second time.

Features of design

Clarified effluent from the primary tanks will flow through a control chamber (DC-2) into the bio-filters. There are two filters each 100 ft. inside diameter with a stone depth of 3 ft. at the walls, increasing to 3.25 ft. at the center. Inflow is below and up through a central column, thence through a rotating distributor onto the stone. Below the stone are vitrified clay filter blocks delivering filtrate into a dual effluent channel which, in turn, discharges through another control chamber (DC-3) to the secondary clarifiers.

In selecting the area of the filters, a B.O.D. was assumed of 0.2 lb. per capita per day. The loading per acre-foot was assumed at 3,000 lb. with 60 percent to the filters. This called for an area of 0.92 acre-foot or, for an assumed 3 ft. depth of stone, 0.31 acre-foot per foot of depth (6,750 acre-feet per unit). By a process of trial, 100 ft. was selected as the diameter of the filter, thus providing a B.O.D. rating of 1.58 lb. per cu.yd.

In computing required digester size, the unit of sludge storage capacity was taken at 3 cu.ft. per capita. This would require, for 20,000 population, a capacity of 60,000 cu.ft., divided between two units. Using a capacity factor of 1.5, the requirement would be 90,000, or 45,000 cu.ft. per unit. However, a capacity of 42,450 cu.yd. was considered ample, this being furnished by tanks having an internal diameter of 50 ft. and a side depth of 20 ft. The bottom of the digesters is hopper-shaped, and the top domed, so that the total overall inside depth is 32.5 ft. The digesters will be buried in the ground for about half their depth and embanked to the brim. The customary floating gas holder was omitted to economize on the use of steel.

One of the features of the digester

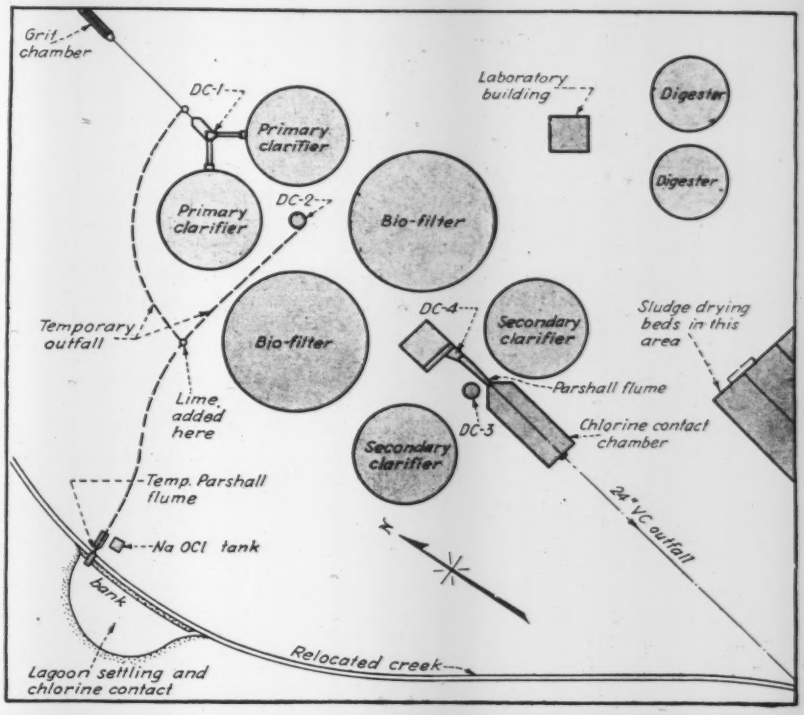


Fig. 2. Bio-filtration process layout for an army camp sewage treatment plant. Temporary facilities for partial treatment of sewage (shown on the left side) were required because troops arrived prior to the completion of the plant.

design is the absence of a central operating chamber, operations being controlled entirely from the pump room in the basement of the nearby laboratory building. The latter houses the plunger sludge pumps, gas-fired boilers for heating the digesters, a coal boiler for heating the building and a completely equipped laboratory. The coal boiler is over-size so as to "pinch-hit" when necessary for a gas-fired unit, and specifically to assume the burden of supplying heat to at least one digester during the early period of use or until sludge gas is being generated at a sufficient rate.

In a similar plant at another army camp, (*ENR* July 30, 1942, p. 173) all pumps, together with the office, laboratory and chlorinator room, were housed in one structure located on the plant axis between the bio-filters and the secondary clarifiers. But in the plant described here only the recirculating pumps—three propeller type, pendant in wells, each with a capacity of 1,450 gpm., and two centrifugals, 125 gpm. each—and the chlorinator room are in the building in the same relative location.

This change was necessitated partly by a difference in site conditions, but more especially by a desire to have the sludge pumps as close as practicable to the digestors, thereby facilitating control of digester operation from within the pump room, and doing away with the more usual in-between control chamber with its numerous objectionable features, not to say costlineess.

Incidentally, another purpose was better served, namely, the opportunity for temporary operation of the plant after arrival of troops and before all of the mechanical equipment, even with highly favorable priorities, could be delivered and installed.

The sludge line from the east primary clarifier, which is at an angle of 45 deg. with the main plant axis, also is the axis of the pump room and of the digesters. It coincides with the sludge discharge line from the digesters (via the pump room) to the sludge-drying beds. As there is a difference in elevation of 6.18 ft. between the water surface in the primary clarifiers and the discharge end at the beds the sludge should flow readily by hydrostatic pressure to the beds.

Temporary operation expedients

Temporary operation was anticipated, and all possible preparations were made so that when troops did arrive the treatment plant would be

able to handle sewage in a reasonably satisfactory manner.

In order to have a better sludge for exposure on beds prior to digestion, pre-liming is contemplated. Post-chlorination, at higher than the regular rate will, in any event, be had, the point of application probably being at the control chamber (DC-2) following the primary clarifiers. Thence, the effluent will be diverted at right angles to the main axis through a temporary 18 in. pipe to the relocated and deepened creek which, a little farther down, will receive the discharge of the regular outfall. A hollowed-out area near the brook will serve the purpose of a temporary chlorine contact pool.

Further downstream the receiving stream broadens into a pond, the outfall level of which will be controlled so as to provide, during the period of temporary operation, for a detention of at least 12 hr., except during spells of heavy rainfall. As a permanent measure this pond is expected to provide further improvement of the plant effluent and to act as a safety factor should an overloading of the plant (as sometimes happens at army camps in wartime) compel the release of a larger fraction than normal (50 percent) of the secondary clarifier effluent.

Post-chlorination of the secondary clarifier effluent will be automatically controlled, the point of application being just ahead of the "jump" in the Parshall flume. The chlorinator itself is located on the first floor of the recirculation pump house, its automatic action being regulated by a differential converter, in turn actuated by a float in a still-well below, this being connected by pipe to the Parshall flume at the third point of the converging level floor section. The same pipe also serves a smaller still-well controlling the float of an indicating and recording flow meter on the same floor as the chlorinator.

The Parshall flume has a throat section of 2 ft. giving a depth of water at peak flow (4.3 mgd.) of 0.93 ft. The floor is at such elevation relative to the water level in the final control chamber (DC-4) as to regulate the "fractioning" of the secondary clarifier discharge between the recirculation pump and the outfall thus, in effect, acting as a broad-crested weir. The pump itself is controlled by a float switch functioning between predetermined levels so as to maintain as closely as practicable the equal division of the secondary clarifier effluent between recirculation and outfall. In theory 50 percent of the flow is regularly returned for passage through the bio-filters a second time.

The pump handling the bio-filter effluent is similarly controlled, again in theory returning 50 percent to be resettled in the primary clarifiers.

A third propeller pump (between the other two) is a variable speed type so that it may supplement one or the other, or take over entirely the burden of either.

Immediately downstream from the Parshall flume is the chlorine detention chamber, a dual unit, each tank 12 x 60 ft., in size with a depth of 3 ft., providing 20 min. detention at peak flow. This unusually shallow depth was necessitated because of the small gradient differential between the tank and the point of outfall and the desire to be able to drain the tank on occasion.

The flume with its approach channel, and the chlorine contact chamber, are really one continuous structure; the continuity, indeed, extends to the control chamber (DC-4) immediately adjacent the wet well which it serves, thus eliminating any loss-of-head therefrom to the pump well, except for a very small entrance loss through the slide gate.

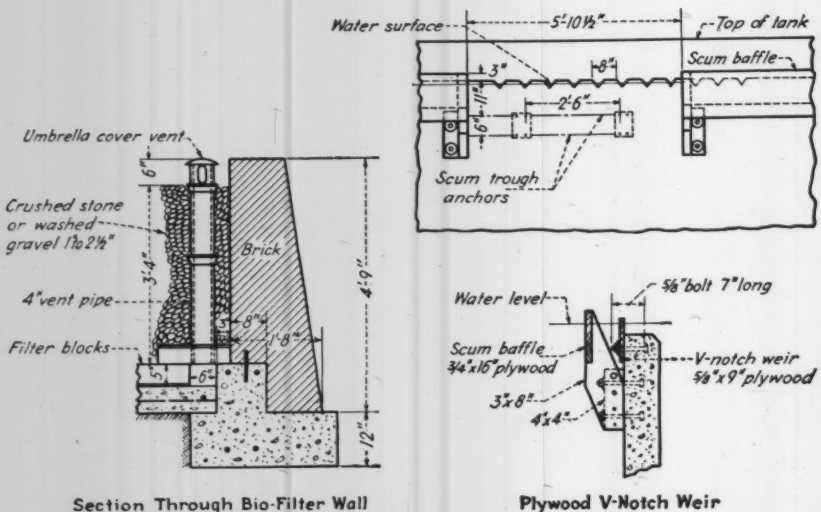
The plant as a whole is very closely coupled and compact, to the end of economizing both hydraulic head and critical materials.

Saving critical materials

To minimize the use of one critical material, cast iron was limited to force mains and piping within structures, the largest size, 12 in., being for the two recirculation lines. All primary sludge lines are 6 in. cast iron. The secondary sludge lines are of 4 in. cast iron. The influent sewer, bypass, outfall, and drains from the comminutor and bar screen chambers, and from the chlorine contact chamber are of vitrified clay or concrete (whichever was the more easily available). All hydrostatic flow pipes are reinforced concrete, with the joints encased.

A departure from usual practice, to minimize the use of steel and bronze, is the use of wood gates—only the lifts of which are of metal—on the recirculation wet well controls. Wood gates are used also to control the route of flow through the screening chamber and the chlorine contact chamber, both dual, but here the use of such is more common. The wooden gates are $\frac{3}{4}$ in. plywood, resin-bonded, the edges filled with a penetrative seal and metal bound. The gate is given two coats of creosote paint.

Where only metal gates would answer the purpose, a simple, relatively inexpensive type assembled with a length of corrugated pipe attached and with a standard frame supporting a standard lift, was found suitable for all but a few situations. The gate with pipe attached is set in the forms, thus dispensing with well castings. Connection is made to the hub of a cast



Section Through Bio-Filter Wall

Plywood V-Notch Weir

Fig. 3. Some interesting details of plant construction. At the left is the design of the brick wall used for the bio-filter tanks. At the right is shown the plywood V-notch weir and scum baffle around the settling tanks.

iron, concrete or vitrified clay pipe merely by caulking the joint with oakum, then grouting and finally encasing the whole joint with concrete.

For valves, and especially on sludge lines, the lubricated plug type, which is a valve and fitting in one, was used wherever applicable. Pump discharge lines generally are equipped with weighted lever check valves supported by solid wedge gate valves. The exception is the two recirculation discharges, which, being above normal water surface in the receiving chambers, were deemed to require only automatic end-gates.

Better operation details

There is a single application of the butterfly type of valve—on the discharge from the secondary sludge pumps which is into the same pipe returning the bio-filter effluent. Since these pumps are purposely oversize—in order to unwater either of the secondary clarifiers on occasion in a reasonable length of time—a means of throttling down of the normal discharge (of secondary sludge) seemed desirable, hence the use of a butterfly valve. When draining the secondary clarifiers, the centrifugal pumps are valved to discharge into the nearest manhole on the by-pass line.

Unwatering of the primary clarifiers is accomplished in large part through the effluent pipe, which is set virtually at the side floor level so as to serve the dual purpose, the inflow from the bottom being controlled by a slide gate. The receiving control chamber (DC-2) is designed to permit the draining of one primary clarifier to the by-pass, while the other side of the chamber is receiving and delivering regular flow between units—at the expense, however, of also keeping out of operation the bio-filter on the same side. This is not of serious moment since to drain a tank requires only a couple of hours, and it would be done, presumably, during a period of low flow when one filter easily would handle the load.

Drainage of the shallow hopper-bottom of the primary clarifiers is readily accomplished using the sludge pumps which, for this purpose, have a discharge connection to a manhole on the by-pass.

Drainage from both sides of the screening chamber is carried to the by-pass. The drains were purposely oversized so as to enable their use to by-pass raw sewage at low flow should it become necessary for any reason to have access to the bottom of the initial control chamber (DC-1).

The connection from the initial control chamber to the primary clarifiers is by means of a flume into a manhole on the side of the clarifier, thence by pipe under the unit to the central influent well. Thus, not only was there a saving in excavation and pipe, but by baffling the flumes and sloping them somewhat more steeply than normal, a simple inexpensive means was provided for better mixing of lime or chlorine should addition of these chemicals be found desirable during temporary operation of the plant. If and when no longer needed, the baffles (of wood) may easily and quickly be detached.

A ready means of "sweetening" the sludge with lime is a permanent provision. In the bottom of the effluent trough of the primary clarifiers where it passes over the scum pit, there is fitted a plug, or "mud" valve, thus permitting water to be admitted into the pit, either for flushing or for admixing with lime introduced at the top. Each pit is connected to its sludge-withdrawal line, the junction being a three-way, three-port lubricated plug valve with an extension permitting surface operation.

Testing and control

Another convenient place to add lime is at a manhole in the supernatant return line. This is located near the laboratory building and serves several other purposes. It is a convenient receptacle for the house sewage and being connected to the sludge pumps suction it enables return of the supernatant to the digesters, with its dosage of lime on occasion, or delivery directly to the drying beds. It is further a very handy place to sample the supernatant as well as to observe and measure the rate of flow. The manhole was sized to afford about 10 min. detention at peak flow. Thence to the initial control chamber the flow is through an oversize pipe on a minimum grade, this being necessitated by the ground conditions.

Fig. 4. Plywood sluice gate being fitted to a diversion manhole.

Piping and valve control in the sludge pumproom is such that either pump may draw on either sludge line and deliver to either digester. The pumps also may be valved to pull on the digester withdrawal lines and either to return the sludge to one or the other of the digesters, or deliver it to the beds. It is possible for the sludge to be flowing to the beds from one digester by hydrostatic pressure while a pump is helping the flow from the other. A by-pass enables sludge delivery directly to the beds, without passing through the digesters. As before noted, the pumps also may be used to complete the unwatering of the primary clarifiers, there being a line on the discharge side to a manhole on the by-pass sewer for this purpose. Except for gate valves supporting checks on the delivery side of the pumps, all control will be had through lubricated plug valves.

The pumps are of the usual plunger type, electrically driven, with 4 in. suctions and discharges, increased immediately to 6 in. (the uniform size of the primary sludge lines) after the air chamber, of which there is one on either side.

The sludge-drying beds follow conventional practice. On the basis of one sq.ft. per capita, the requirement would, in this case, be 20,000 sq.ft. Actually 24,000 sq.ft. have been provided, with space reserved for expansion up to double or more. The bed is divided in units, 30 x 100 ft. in area. For bed divisors, planks are used with earth embankments elsewhere except for the points of access where a low retaining wall of concrete serves also as a sill, and along the upper side where because of the high bank it was deemed advisable to provide a concrete retaining wall. The only other concrete is for splash plates, and to encase the underdrains where they would be crossed by a

vehicle backing in to load sludge. Shear gates control the flow from the sludge pipes. The containing embankments, plank divisors, and concrete walls are at a level to permit up to 12 in. depth of sludge. For wood, California redwood was specified as the choice over creosoted pine, but in view of the stringency and rush, permission was given to use untreated structural grade spruce.

A brief exposition of the pipe sizing may be of interest. A 24 in. size was used throughout for the sewage flow. Using for *n* the value of 0.013, this size has a theoretical carrying capacity (Manning's formula) of 7.10 cfs., as against 6.63 cfs. for the estimated peak flow of 4.3 mgd. On the recommended minimum slope of 0.95 /1000, a 21 in. pipe would have been ample, and on a slope of 1/1000 more than ample. Hence, there is a modest safety factor in the size chosen, equal to expansion up to 4.6 mgd. The provisions for by-passing with only primary treatment will, it is anticipated, permit the plant to handle, for short periods, somewhat in excess of this gallonage without creating seriously objectionable conditions in the stream below.

Direction and supervision

Design generally was by J. R. Worcester & Co. of Boston, acting through Roscoe E. Estes as chief administrative engineer, with C. W. Kimball, of Richard D. Kimball Co., Engineers, Boston, associated as chief engineer for utilities and the author as designer for the treatment plant. Immediate supervision of construction was under R. G. Lingley of Worcester. The project was under the direction of Major M. R. Gilpin, Jr., area engineer and Col. H. S. Bishop, district engineer, Providence District, Corps of Engineers. Weston and Sampson, of Boston, served as consultants during the initial stages of design and were instrumental in determining the type of treatment adopted.

ACI Recommended Stresses For Unreinforced Concrete

AS AN AID TO ENGINEERS who may be required in the interest of steel conservation to extend the use of unreinforced concrete to structures not commonly built with this material, a committee of the American Concrete Institute has prepared a report on recommended stresses for unreinforced concrete. The report, published in the November *Journal* of the Institute, is in the form of a proposal to elicit discussion, but as it represents the conclusions of experts in the field, it may be considered authoritative.

Committee members are A. J. Boase, George A. Maney, Douglas E. Parsons, Chester L. Post, A. W. Stephens and L. C. Urquhart. The report follows:

Unreinforced concrete

These provisions cover the use of unreinforced concrete and they are to be used in conjunction with "Building Regulations for Reinforced Concrete" (ACI 318-41).

As an alternate to the compressive strength as a control for the quality of concrete, the flexural strength may be used. If flexural strength is used as the control, then tests shall be made in accordance with the "Standard Method of Test for Flexural Strength of Concrete" (ASTM C78-39). Curves showing the relation between water content and flexural strength shall be made in the same manner as required for tests involving water content and compressive strength. The requirements for field testing shall be as required by ACI 318-41 for compression tests.

Joints, permitting free movement, shall be provided at frequent intervals in straight walls or similar members to reduce to a negligible amount the tensile stresses resulting from volume changes. Such joints shall be spaced not to exceed 16 ft. in members exposed to the weather and not to exceed 32 ft. in members which are protected from considerable changes in temperature and moisture content.

Concrete arches and domes shall be designed so as to keep the combined stresses, including those due to volume changes, within the allowable limits.

The stresses in concrete shall not exceed the values given in this section where f'_c equals the minimum compressive strength and f'_x equals the minimum flexural strength, both determined at 28 days or at the earlier age at which the concrete may be expected to receive its full load. The stresses given apply to controlled concrete only.

The allowable compressive stress on piers (height not exceeding 3 times least lateral dimension) shall be 0.25 f'_c. Where the height does not exceed 10 times the least lateral dimension, the allowable stress shall be 0.25 f'_c for walls and 0.20 f'_c for columns. For walls or columns of greater unsupported height, the allowable load shall be reduced in accordance with formula 26 of ACI 318-41.

Where reinforcement uniformly spaced at not more than 4 in. centers and weighing not less than 0.3 lb. per sq.ft. of surface area is used, the allowable extreme fiber stress in tension as given in the table may be increased 25 per cent except for arch and dome construction. This steel is to be placed in the direction of stress and not more than 1 in. from the tension surface of flexural members.

DESIGN DATA FOR UNREINFORCED CONCRETE

	Allowable Stresses	
	Based on Compressive Strength: f'_c	Based on Flexural Strength: f'_x
Flexure: f_s		
Extreme fiber in tension	$.05 f'_c$	$.33 f'_x$
Extreme fiber in tension for arch or dome construction	$.08 f'_c$	$.50 f'_x$
Shear: v		
Shallow members $\left(\frac{d}{b}\text{ less than }4\right)$	$.02 f'_c$	$.13 f'_x$
Deep members $\left(\frac{d}{b}\text{ more than }4\right)$	$.03 f'_c$	$.20 f'_x$
Bearing: f_s		
On full area	$.25 f'_c$	$1.5 f'_x$
On ⅓ area or less	$.375 f'_c$	$2.25 f'_x$

Note: In the design of footings, the lower 2 in. of concrete shall not be included in calculations for stress.

HIGHWAY OPERATIONS UNDER WAR CONDITIONS

A special section containing a discussion of problems brought to the state highway departments by the war restrictions under which they must operate, and two articles on major war-road construction projects.

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The National Highway Situation
THOMAS H. MACDONALD

Road Plans and Expenditures
AN ENR COMPILATION

Keeping Road Equipment in Service
FRANK KELSO

Michigan Builds War Roads

Maintenance During the War
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Keeping Trucks Rolling in Oregon
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Virginia Roads on War Basis
J. J. FORRER

Maintenance and Finance Discussions

Alcan Highway: Part III—H. W. RICHARDSON

★

The National Highway Situation Under War Conditions

Thomas H. MacDonald
Commissioner of Public Roads
Washington, D. C.

***Contents in Brief**—Highway construction in the past two decades has been largely replacement of roads that have gone to pieces under rapidly increasing traffic or have been outdated. If the nation's great war production effort is not to be handicapped by a breakdown of highway transportation, a program of extraordinary highway maintenance must be made possible. Otherwise, roads that normally would have been replaced in the war period will go to pieces under the greater load they are required to carry. Statistics show that though gasoline restrictions and rubber scarcity will reduce motor vehicle registrations in 1943, the remaining vehicles will be used more intensively and will carry greater average loads.*

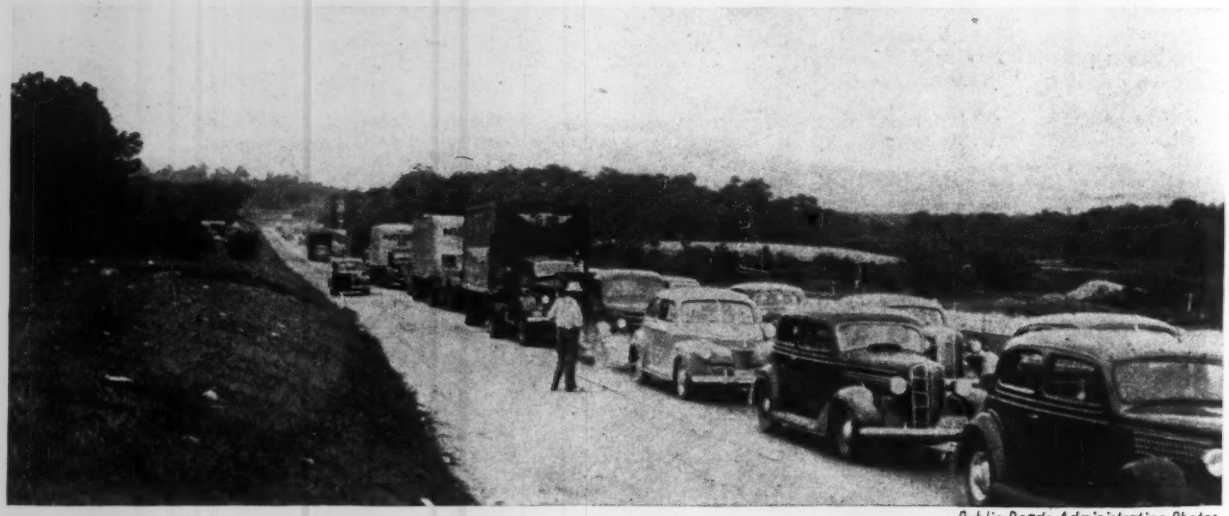
A YEAR AGO, when we entered the war, the country was fortunate in its possession of a fairly modern and reasonably efficient system of highway transportation. The conditions under which we were operating were far better than those which confronted us when we entered the last war. There had been nearly a quarter of a century of nation-wide road building which had been carried forward at a high rate in good times and bad. Consistently, year after year, the building of highways had kept pace with the provision of motor vehicles to operate over them—the combination of the two making up the highway transport industry.

Between the two wars we had developed a highway organization composed of state and federal agencies the units of which had demonstrated a capacity to carry out large programs of highway improvement and had reached adjustments of their mutual relations without sacrifice of either state sovereignty or federal objectives. We are now fortified in making administrative decisions by the factual results of the state-wide highway planning surveys. The steady advance in highway engineering knowledge has made possible in recent years a scientific approach to problems in place of what was formerly little more than guesswork.

The development of efficient construction equipment in the field of road building has eclipsed the similar developments in any other field of construction.

In the years preceding our entry into the war the unusually large domestic markets of new vehicles for use by new owners and as replacements, together with our normal stocks of used vehicles, had fortunately provided the very large inventory of tires on hand and in use, which is now our best insurance against the catastrophe of rubber shortage.

An analysis of the operations in



Public Roads Administration Photos

The tremendous migrations of military and industrial activities occasioned by our participation in the war, involving as it does shifts of workers, materials and supplies, have imposed burdens on highways that were never intended to handle the traffic volumes or gross weights to which they are now subjected.

the interval since the last war reveals changes of greatest importance in our administrative plan and routine of operations. The change from local to state control of all major highways; the establishment of the state highway systems; the designation of the federal-aid system, and later of the carefully planned secondary system; the selection with the War Department of a strategic network important to the military establishments and in conformity with the needs of a nation at war have been steps in the coming of age of highway policies and administrative practices which, in the light of our existing situation, have been more nearly productive of useful results than any other policy might have provided.

Many types of highway expenditure will need to continue throughout the war if adequate facilities are to be available for movement of essential traffic. Increasingly, there is evidence of the transfer of emphasis from the initially important objective of maximum production to the resulting problem of distribution. We cannot permit shortages in transportation to result in a breakdown in war distribution.

Changed conditions

These are a few of the major resources and assets that were made available to our war effort a year ago. The past year has introduced a number of significant changes in the normal pattern. It has been productive of shortages, limitations and restrictions. At times there have seemed to be more disappointments than assurances, more red than green signals, but this is wartime and therefore no time to complain or criticize. Rather, we must devote our energies, for the duration, to the preservation of what we have.

Despite the realistic implications of an undimensioned tire shortage, the consequent nation-wide extension of motor fuel rationing and the yet undisclosed proportions of income, manpower, material and equipment that must go into the war effort, the outlook for the future is not altogether discouraging. Unquestionably the amazing continuity of operations which has characterized the peacetime development of highway transport has produced an inertia of movement that resulted in severe and uncomfortable dislocations and reactions when it became necessary to slow the speed and change the direction of effort. The realization and resolution of these conditions have moved apace during the past year. Progressively the attention of administrators has been brought to bear on the problems of highway transport and much progress has been made in righting initially wrong premises and consequent misunderstandings. Looking forward, then, we must continue to marshal such facts as will prevent the perpetuation of these misunderstandings of the needs of highway transport, recognizing the inescapable conclusion that many types of highway expenditures will need to continue throughout the war if adequate facilities are to be available for the movement of essential traffic.

A crisis ahead

The war program of highway improvement has necessarily been limited. After war becomes imminent, it is too late to build a system of roads. While serious inadequacies existed on our main road system when measured by fixed standards, there has been no widespread breakdown of the highway transport system because of road failures; but we are now approaching a critical time that may become a crisis in highway transport. Since Dec. 2, 1941, no projects involving federal funds have been approved which were not certified as essential to the war effort by an appropriate federal defense agency. Since these certifications come from outside the road forces and have been largely predicated on direct military interest, many projects which highway officials believe highly necessary for national defense have not been certified, and many of those certified have been delayed by the involved process for obtaining priorities and the competitive character of strictly military construction. There are indications that the peak of such construction is being reached, the passing of which should free larger amounts of materials and equipment for the preservation of essential civilian operations.

A fundamentally unsound premise has existed to the effect that our annual program of construction which has been carried forward on the main roads of the federal-aid and state highway systems consists only of new roads. The misunderstanding leads to the conclusion that the mileage constructed each year adds to the number of miles of roads in service and ignores the true fact that the program over a long period has been the reconstruction, replacement and modernization in accordance with the traffic demands of roads that are already in service. Once the wrong premise is adopted, the conclusions that emanate are wrong. In order to understand what has been happening since the last war, it is necessary to obtain a correct visualization of the annual program of highway construction as it actually is. For many years predominantly, and in recent years exclusively, the program of highway building has been a program of replacement and reconstruction.

Replacement and reconstruction

The main roads of the nation, inclusive of the federal-aid highways, consist of designated systems known as state highways. We need go no further back than 1923 to establish the facts relative to the development of these state systems. In the 18 years between 1923 and 1942, for which complete records are available, the primary systems of rural state highway increased in length from 251,610 to 331,567 miles, a net addition of approximately 80,000 miles or 32 percent of the length in 1923. In the same period, construction on these primary systems totaled 501,192 miles, an excess over the length of the finally existing systems in 1942 of 169,625 miles. In other words, the entire enlarged system has been in effect reconstructed or replaced one and one-half times in an 18-year period.

The continuing trend of replacements, reconstruction and modernization on the integrated state systems is established by consideration of the whole period, divided into three 6-year periods, as follows:

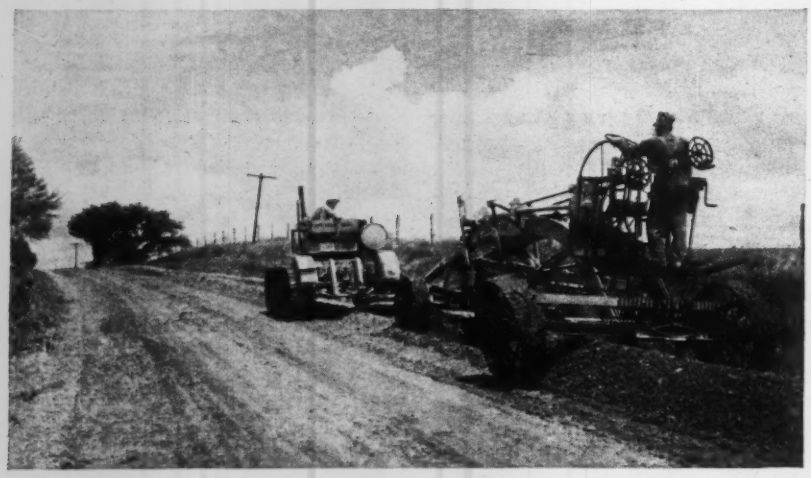
Period	Net increase in system miles	Total miles built
1924–1929	62,553	161,365
1930–1935	17,704	200,050
1936–1941	—300	139,777

The mounting gains in over-all traffic volumes, which have made necessary the raising of highway types and standards represented in the trend in road replacement, are no less spectacular. During the 18-year period, the number of motor vehicles in operation increased 127 percent

from some 15 million to more than 34 million. In 1923, the 15 million odd vehicles consumed 2.4 billion gallons of motor fuel. For the year 1941 more than 24 billion gallons were consumed, the increase being 918 percent. Between 1929 and 1940 the total load carried on rural main roads rose from approximately 14 billion ton-miles to more than 47 billion ton-miles. More than three and one-half times the freight load carried on the main roads in 1929 was carried in 1940 on a system of roads only 6 percent greater in length. This has been possible only through a steadfast state and national policy of essential replacement and intensive maintenance.

It is already apparent that the mounting industrial activity attendant on the war effort has imposed steadily increasing demands on most phases of highway transportation. In view of the virtual cessation of replacements both of rolling stock and the roadbed, and in consideration of other limitations and restrictions, the elimination of all nonessential highway activity will fall far short of compensating for the demands being placed upon essential highway transportation.

Other essential war construction has heavily tapped the reservoir of private construction facilities ordinarily required to carry on the annual program of highway replacement. Shortages in manpower, equipment, materials, and in highway revenues have all combined to drastically limit and curtail the volume of needed replacement and reconstruction which may be declared essential in this period of expanded war activity.



Reconditioning operations of the type here shows are having to be deferred due to shortages of materials and inability to replace worn out equipment.

Perhaps the best estimate of the prospects or potentialities for 1943 may be deduced from an analysis of what has happened in 1942, the first war year. During that year the use of all federal highway funds was restricted to projects certified as essential to the national defense by an appropriate war agency.

Commitments for 1942

Total obligations of federal-aid funds on such certified projects during the first ten months of the calendar year 1942 amounted to $65,625,685 for the construction of 513 projects totaling 1,057.3 miles on the federal-aid highway and secondary systems. Other emergency funds to the extent of $451,536 were expended from remaining balances. Access road funds obligated amounted to $195,448,851 for 1,008 projects on 4,249.4 miles of road, principally off the system and designed to provide access from military, industrial and raw material sites to such main road systems. Obligations for work on the strategic network of highways, largely included in the primary system of state highways, amounted to $10,695,533 for 106 projects on 156.9 miles of road. The total 1942 obligations to Oct. 31 therefore provide for the construction of 1,623 projects totaling 5,463.6 miles in length at a total estimated cost of $272,221,605.

Obligations during 1941 made without the restraints imposed by wartime restrictions amounted to $282,672,479 for the improvement of 3,835 projects totaling 8,962.6 miles. This compares with the 1942 obligations other than access roads, amounting in ten months to $76,772,754 for 615 projects on 1,214.2 miles of improvement, principally on main roads.

New work declines rapidly

Based on the first ten months of 1942, the estimated mileage of projects on the federal-aid system completed with federal funds is less than 72 percent of the mileage completed in 1941. This low rate of completions, however, does not accurately portray the real trend. It is estimated that the mileage under construction at the end of 1942 was only 38 percent of that in progress a year earlier. This estimate is predicated on the rather alarmingly reduced rate at which improvements are currently being placed under construction.

In the calendar year 1941 some 7,235 miles of replacement and reconstruction projects were placed under construction. For the calendar year 1942 the total will be approximately 1,586 miles or but 22 percent of the previous year. Based on the monthly trend in the decline of projects placed under construction it is estimated that less than 375 miles will be possible in 1943 unless drastic revisions are made in policies presently restricting such improvements. Continuation of the recent trend in placing projects under construction, together with the low volume of work currently under way, will curtail the mileage completed in 1943 to less than one-third of normal requirements.

State operations hampered

State data for 1942 are not available to permit a corresponding comparison of the trend of non-federal construction on the primary system of state highways. However, it is apparent that priorities restrictions have similarly hampered the states in their own programs. Comparative employment data on state and federal highway construction by private contractors show a decrease of 38 percent from the first nine months of 1941 to the corresponding period of 1942. Data for recent months show that this situation is progressively aggravated, with an indicated reduction of 49 percent in contract construction activity. The latter comparison covers the period when such activity is usually at its peak.

Serious effect in some states

The impositions placed upon the retention of the fullest utility of the existing facilities for highway transportation must be wholly justified by the facts. Viewed from the national angle, the outlook is not too dark but it should be obvious that the various restrictions will strike with varying severity in the several states. Accordingly, as the decrease in revenues under nation-wide gasoline rationing continues into 1943, some states may not have sufficient funds to maintain their main roads in adequate condition even after the elimination of replacement construction. The continuance of heavy fixed charges in connection with decreased revenues may force drastic revisions in current financial policies and laws regulating the existing division of funds between state and local governments, in order to preserve for the war effort the utility of the essential highway elements.

Highway travel in 1943

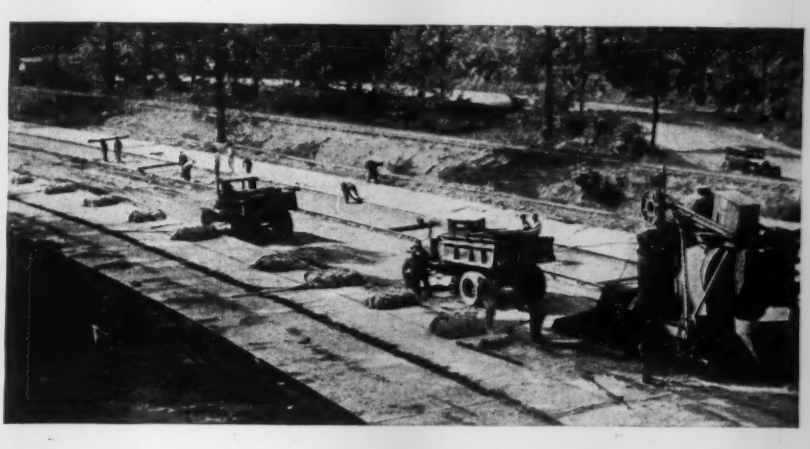
For the country as a whole, the measure of the prospective travel and the resulting highway revenues for 1943 is likewise afforded by a comparison of available 1942 data with normal activity. Based on eight months registration data and motor fuel consumption in 1941 and 1942, certain comparative estimates are available to indicate the effects of gasoline rationing and the future implications of change in the status of highway travel.

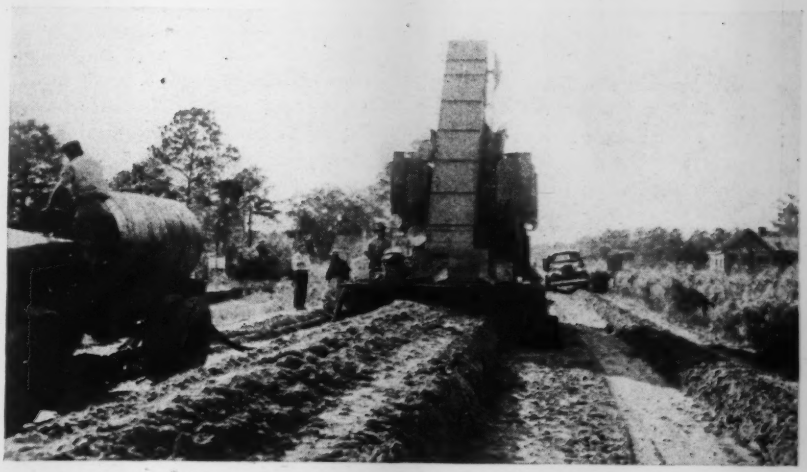
Total registrations in 1942 were approximately 8.4 percent less than in 1941. These are indicated at 26,763,000 passenger cars, off 9.0 percent from the previous year, and 4,641,200 trucks, off 4.8 percent from 1941. Of considerable significance is the indicated flight of vehicles from the initially rationed eastern states, which probably is a component of the general migration of military, industrial and manufacturing activity incident to the war effort. Registrations decreased 9.8 percent in the initially rationed states and 7.7 percent in the remaining states.

Motor fuel consumption

The estimated motor fuel consumption for the calendar year 1942 is 16.9 percent less than consumption in 1941. For the year, motor fuel consumption in the initially rationed states was off 25.2 percent from 1941 as compared with a reduction of 12.2 percent in the remaining states. The 16.9 percent reduction in the use of motor fuel by all vehicles was composed of a 24.2 percent decrease in such use by passenger cars with an *increased* use by trucks amounting to 8.8 percent.

The estimated change in the use of





Normal federal-aid construction has been suspended except on projects having immediate significance to the war effort, thus making it necessary to maintain roads that should be replaced due to the high cost of keeping them in condition.

motor fuel from 1941 to 1942 is shown in the accompanying table:

The estimate for the final month is based on national gasoline rationing at consumption rates per vehicle typical of the previously rationed area. It is probable that these trends in 1942 will be characteristic of 1943, depending upon the relative availability of tires and of motor fuel including distribution facilities.

Vehicle registrations decline

The continuation of the trend in registrations during the past year through the coming year will reduce the number of passenger cars by about 2,250,000 and the number of trucks by about 225,000. The registration fees to be paid by the less than 25 million vehicles remaining in service are estimated to be not more than 15 percent below those collected in 1941 for the country at large.

Trucks remaining in service are expected to be subjected to much more intensive use and to account for an increase in motor fuel consumption of approximately 12 percent. Combined with the further reduction of motor fuel consumption by passenger cars remaining in service, the indications are that total motor fuel tax collections in 1943 will drop not more than 32 percent below levels prevailing in 1941.

Viewed from this angle, the resulting highway transportation activity will be stripped of nonessentials and will constitute the barest minimum essential to the wartime preservation of production and distribution. The movement of persons appears to be in greater jeopardy than the movement of goods. The marked reductions in the number of vehicles in service, especially of trucks, will result in increasing the need for their services. The resultant increase in average carried loads will largely offset the decrases in traffic on particular routes.

In 1943, highway transportation activity will constitute the barest minimum essential to wartime preservation of production and distribution. The marked reduction in the number of trucks in service will result in increasing the need for their services. The resultant increase in average load carried will largely offset decreases in traffic on particular routes. Hence, virtually all our main roads will need to be preserved in a safe and usable condition.

This year, then, all highway transport will be essential wartime transport and virtually all of our main roads will need to be preserved in a safe and usable condition.

Effect of industry shifts

The tremendous migrations of military, industrial and manufacturing activity occasioned by our active participation in the war and involving shifts of workers, materials and supplies have already imposed burdens on highway systems which were never constructed or improved to handle either the traffic volumes or gross weights to which they are now subjected. The provision of some 4,200 miles of access roads to camps, cantonments, naval bases, and manufacturing and industrial sites, frequently in virgin areas, has likewise imposed burdens which strain the capacity of main roads to which the access roads connect.

The requirements for replacement and reconstruction have already been severely curtailed. They are not being effectively met by the day-to-day, piecemeal consideration of individual project allotments of critical materials and equipment. They are being thwarted by the continued dissipation of experienced construction manpower and contractual facilities. For the future, then, we should anticipate the requirements of the highway transportation industry on a program basis that will assure consideration of essential materials, equipment and manpower for at least a minimum mileage of essential construction proportionate to the essential travel which must be preserved for the war effort.

Extraordinary maintenance needed

To offset the enforced reduction in the rate of highway replacement by new construction it will be obligatory that we resort to extraordinary maintenance as a mandatory, though uneconomical, expedient. Such an expanded program of both more extensive and more intensive maintenance will require not only the absolute retention of all existing personnel, equipment and material facilities of the organized state highway departments, but also the pooling and efficient cooperative use of those facilities of the minor highway administrative agencies. In addition to the retention by the departments of their operating maintenance equipment, it will be necessary for them to have access to essential repair parts and to be authorized to make replacements of such essential equipment as can no longer be kept in operation, and to speed up the procedures for their procurement.

The state highway departments will also require a considerable volume of repair and patching materials and quantities of the less critical materials such as bitumens and timber for the repair and strengthening of faltering structures. It will be imperative that these departments set up and maintain, on a program basis, inventories of current and prospective material requirements in order that these may be given joint consideration with other important war material needs.

Any main road today is an existing war facility and a potential military road. The alternative to the provision of necessary replacement and reconstruction is extraordinary maintenance. The alternative to the failure to retain the full facilities for the provision of such maintenance is a gradual but creeping paralysis of transport upon that road. These facts are contained in the record of the past but the final evidence may be no further ahead of us than the next spring thaw.

CHANGE IN USE OF MOTOR FUEL FROM 1941 TO 1942

Month	Per cent change in initially rationed States	Per cent change in remaining States	Per cent change in U. S.
January	+ 2.67	+ 5.51	+ 4.47
February	— 5.12	— 4.67	— 4.84
March	— 5.77	— 5.08	— 5.33
April	—16.28	—11.76	—13.37
May	—25.86	—16.39	—19.77
June	—25.04	—10.89	—16.14
July	—24.72	—18.67	—20.88
August	—39.57	—20.29	—27.52
September	—28.99	—18.12	—21.96
October	—32.16	—17.00	—22.49
November	.....	.....	—21.78
December	.....	.....	—33.33

Highway Expenditures and Plans

RADICAL CHANGES in highway activities are reflected in available figures for highway work in 1942 and estimates for 1943. Construction expenditures declined sharply in 1942, closely approaching expenditures for maintenance and equipment. Estimates for 1943, such as have been made, show that maintenance expenditures this year will exceed expenditures for construction.

When the year 1942 opened, highway programming was still guided by the defense philosophy of the preceding years; improvement and strengthening of the strategic network then held high place in plans for the coming year. Today that thinking is out for the duration. All thinking now is centered on how to keep what highways we have in condition to carry the load that war is putting on them. Maintenance has been advanced to first place in most states in budgeting future work.

This fact is not fully reflected in the accompanying table, due chiefly to a considerable carryover of new construction that was under way when WPB Order L-41 was issued in April forbidding initiation of practically all new construction without special authorization from the War Production Board. Work already under way went forward as best it could. In December, further curtailment of construction was ordered, including many highway projects that were under way or had been authorized previously.

Similarly, such estimates of new work as have been made for 1943 probably do not accurately reflect anticipated expenditures; the budget figures, in large measure, show work that is on the books which it is hoped can be done in 1943.

The 1942 figures for new construction include a considerable amount of access road work, which work probably will decline in 1943.

Many highway department heads will not hazard a guess as to their maintenance expenditures for 1943. Of those who have made such estimates, about half expect to increase their expenditures for maintenance, and only two states, New Jersey and West Virginia, anticipate large cuts. Increases are due, in large part, to inability to replace pavements that normally would be replaced because of the high cost of upkeep. Also, an increase in the average load now being carried by trucks is speeding the deterioration of pavements.

The table below gives road construction figures and expenditures for 33 states. Figures for the remaining states are not yet available.

CONSTRUCTION RECORDS AND EXPENDITURES FOR 33 STATE HIGHWAY DEPARTMENTS

	Mileage Completed — 1942					Estimated Mileage — 1943					Additions to Strategic Network (miles)		Access Roads (miles)		Expenditures — 1942			Expenditure Budget 1943		
States	Total	Pave-ment	Dust-less	Non-Dust-less	Graded & Drained	Total	Pave-ment	Dust-less	Non-Dust-less	Graded & Drained	1942	1943	1942	1943	Total	Con-struc-tion	Maint. & Equip.	Total	Con-struc-tion	Maint. & Equip.
Maine	55.0	6.0	29.0	20.0	.....	.....	.....	.....	.....	.....	26.2	12.1	5.4	11.2	$6,694	$2,714	$3,980	$4,900	$1,500	$3,400
New Hampshire	57.4	0.4	50.0	7.0	.....	10.0	.....	8.0	2.0	.....	....	....	....	10.0	4,772	2,142	2,630	3,075	600	2,475
Vermont	37.2	4.8	32.4	.....	.....	14.3	0.3	14.0	.....	.....	4.6	1.7	4.0	12.6	2,040	825	1,215	1,175	.....	1,175
Massachusetts	19.0	19.0	.....	.....	.....	.....	.....	.....	.....	.....	....	....	7.0	....	5,553	2,760	2,793	.....	.....	.....
Rhode Island	9.6	7.5	.....	.....	2.1	.....	.....	.....	.....	.....	2.5	....	4.6	....	3,124	1,521	1,603	1,727	177	1,550
Connecticut[1]	78.8	51.0	11.0	7.6	9.2	114.0	71.0	34.0	7.0	2.0	....	21.0	....	7.0	19,994	16,050	3,944	12,982	9,687	3,295
New York	65.0	53.8	3.6	3.9	3.7	.....	.....	.....	.....	.....	....	....	46.3	....	14,000	4,000	10,000	.....	.....	.....
New Jersey[2]	25.3	18.6	2.2	.....	4.5	31.5	23.1	8.4	.....	.....	16.0	5.9	4.4	22.4	10,180	5,593	4,587	5,690	4,483	1,207
Pennsylvania	1,000.2	329.5	651.4	13.4	5.9	.....	.....	.....	.....	.....	39.6	....	15.9	....	52,970	36,500	16,470	18,500	.....	18,500
Delaware	20.1	0.1	4.8	13.2	2.0	.....	.....	.....	.....	.....	....	....	....	....	.....	.....	.....	.....	.....	.....
Virginia	345.3	224.7	49.3	36.6	34.7	209.0	179.9	8.2	8.6	12.3	48.4	....	42.2	...	28,352	15,774	12,578	26,359	15,000	11,359
West Virginia	108.1	33.4	70.6	.....	4.1	8.8	8.8	.....	.....	.....	8.4	3.9	23.2	4.9	14,825	5,825	9,000	7,870	1,770	6,100[3]
North Carolina	294.0	101.0	81.0	64.0	48.0	.....	.....	.....	.....	.....	18.0	....	10.0	....	16,404	4,750	11,654	.....	.....	.....
Mississippi	240.8	111.1	48.7	.....	81.0	105.3	27.3	.....	.....	78.0	....	....	....	5.2	7,161	4,817	2,344	5,856	4,056	1,800
Louisiana	3,884.7	20.0	142.5	3,718.9	3.3	2,040.0	78.2	59.3	1,902.5	.....	....	....	....	....	10,685	8,585	2,100	13,609	10,579	3,030
Kentucky	197.0	64.0	70.0	16.0	47.0	97.0	32.0	40.0	.....	25.0	64.0	21.0	45.0	4.0	14,828	8,892	5,936	9,035	4,035	5,000
Ohio	4,124.7	633.0	3,390.0	100.0	1.7	3,125.0	425.0	2,650.0	50.0	.....	23.0	12.0	41.0	20.0	36,342	20,482	15,860	24,950	11,300	13,650
Indiana	1,885.0[4]	243.0[4]	1,531.0	75.0	36.0[4]	.....	.....	.....	.....	.....	89.0	....	14.0	....	21,937	17,186	4,751	.....	.....	.....
Illinois	450.6	232.9	117.1	71.4	29.2	.....	.....	.....	.....	.....	....	....	61.5	....	.....	.....	.....	.....	.....	.....
Wisconsin	449.0	79.0	146.0	163.0	61.0	.....	.....	.....	.....	.....	22.0	....	84.0	....	12,285	8,085	4,200	7,100	2,500	4,600
Michigan	256.4	83.5	153.1	19.8	.....	207.5	7.5	200.0	.....	.....	....	....	34.9	10.0	23,425	16,000	7,425	8,815	2,500	6,315
North Dakota[2]	212.0	.....	43.0	115.0	54.0	181.0	.....	116.0	32.0	33.0	83.0	110.0	....	....	3,985	2,250	1,735	3,160	1,500	1,660
South Dakota	204.0	.....	119.0	54.0	31.0	248.0	.....	146.0	50.0	52.0	55.0	....	9.0	....	3,425	1,455	1,970	3,500	1,500	2,000
Nebraska[2]	291.0	15.0	46.0	219.0	100.0	83.0	9.0	45.0	29.0	.....	33.0	7.0	8.0	1.0	5,835	3,570	2,265	3,000	.....	3,000
Kansas	523.0	20.0	125.0	183.0	195.0	.....	.....	.....	.....	.....	11.0	....	5.0	22.0	9,095	5,345	3,750	.....	.....	.....
Montana	43.8	.....	43.7	.....	0.1	.....	.....	.....	.....	.....	6.8	....	34.8	....	5,177	2,655	2,522	3,850	1,250	2,600
Wyoming	168.0	.....	146.0	22.0	.....	4.1	.....	4.1	.....	.....	22.6	....	4.1	....	3,085	2,100	985	1,350	300	1,050
New Mexico	180.0	99.0	18.0	40.0	23.0	145.0	75.0	20.0	30.0	20.0	....	....	7.0	10.0	4,922	2,900	2,022	.....	.....	.....
Arizona	100.0	1.0	78.0	12.0	9.0	50.0	8.0	42.0	.....	.....	....	....	10.0	35.0	4,287	2,760	1,527	3,885	2,180	1,705
Nevada	140.0	.....	124.0	16.0	.....	.....	.....	.....	.....	.....	60.0	....	53.0	....	3,769	2,656	1,113	.....	.....	.....
Washington	372.5	27.5	239.0	106.0	.....	517.8	14.8	354.0	140.0	9.0	....	....	....	4.3	7,650	4,417	3,233	8,410	4,300	4,110
Oregon	672.0	92.0	151.0	239.0	190.0	214.0	36.0	25.0	78.0	75.0	....	....	22.0	42.0	11,260	6,500	4,760	10,060	5,000	5,060
California	382.0	296.0	78.0	.....	8.0	.....	.....	.....	.....	.....	106.0	....	84.0	....	49,320	39,245	10,075	29,000	18,300	10,700

FOOTNOTES: [1] Fiscal year. [2] 1943 data is for carryover only. [3] Includes $500,000 in equipment overhaul. [4] In addition there are 92 miles pavement widening and 172 miles widening shoulders.

The road work that can be done in 1943 depends in large measure on the amount of equipment that can be kept in service.

Keeping Highway Equipment in Service Despite War Restrictions

Frank Kelso
Superintendent, Wyoming Highway Department
Cheyenne, Wyo.

***Contents in Brief**—Regular replacement of maintenance equipment and a thorough system of repairs has put the Wyoming Highway Department in good shape to meet conditions growing out of the war. All equipment is controlled by 31 maintenance centers and periodic inspection is required.*

FOUR YEARS AGO the Wyoming Highway Department started a campaign to replace old equipment as rapidly as possible. Today that campaign is paying large dividends. When the present shortages of materials and equipment struck, it found Wyoming's equipment in excellent condition, although somewhat short, as this past year's anticipated purchases never materialized.

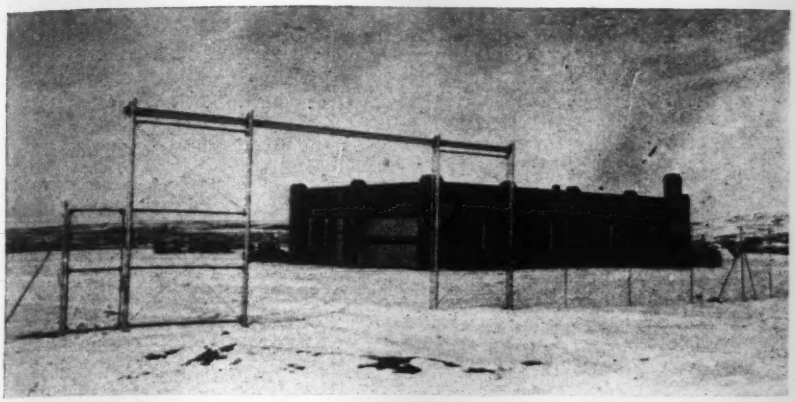
Wyoming's favorable position finds its origin in a decision reached some years ago to abandon the patrol system of maintenance, concentrating maintenance at 31 different points in the state. At that time a long-range program was inaugurated under which modern buildings were to be built at these strategic points to be used as headquarters for the maintenance engineers and their equipment and to accommodate modern repair shops. These buildings vary in size from 40x80 ft. to 80x120 ft., and each building is designed to fit the conditions at its particular location. That is, the size of the building is determined by the importance of the station, the number of pieces of equipment working out of that station, and the amount and type of repair work to be done. At 22 of these locations, new modern buildings have been built. In the three years immediately previous to 1942, twelve of these buildings were constructed and several others were programmed for 1942 and 1943 but, due to the war, these did not materialize.

All of the new buildings are brick and modern in all respects. The main portion of the building consists of a large storage room. Entrances by large pull-up doors, are provided at the end and one one side. One end of the building is partitioned off into three rooms, one for an engineer's office, one for clothes lockers, toilets and showers, and the third one for a stock and supply room. Repair work is done in the large storage room. In one corner is an overhead crane, work benches, battery charger, air pump and various other repair and maintenance equipment. The amount of equipment at each station is dependent upon the amount of repairs to be done at that particular point.

Heating is accomplished by hot-water overhead radiators with fans. Fuel is either coal or natural gas. The furnace room is outside of the main building, as shown in the accompanying picture of the Douglas building.

Floor drains are provided in sufficient numbers to insure proper drainage of the concrete floor.

Gasoline storage and pumps are outside of the building but inside of the fenced yard. All yards are suffi-



Well fenced yards of ample capacity are provided at each maintenance center for the storage of equipment.

ciently large to provide ample storage space for lumber and culverts.

Major overhauls and repairs to equipment can be made at thirteen shops where mechanics are employed. However, all shops are sufficiently equipped to make minor repairs; in cases of emergency, a mechanic from one of the larger shops has available enough equipment to be able to make the necessary repairs.

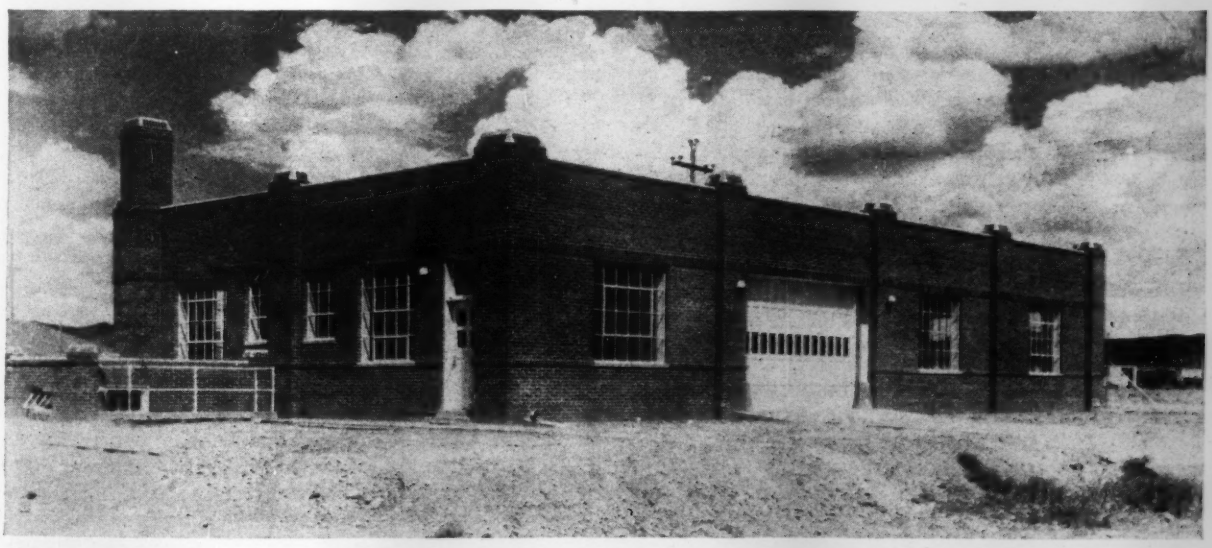
Following the start of the replacement campaign four years ago, all automobiles and trucks were traded in at about 50,000 mi. Motor graders, shovels, etc., were replaced before the cost of maintaining them became large. As a result, a saving of $50,000 a year in repair costs has been made.

Following the outbreak of war, as it became more apparent that repair parts would be progressively more difficult to obtain, every piece of equipment which, upon inspection, indicated needed repairs, was either overhauled or the necessary repair parts purchased and placed in stock for future use. Consequently, at the present time, only a very few units are out of commission for an indefinite period of time. A small number of units are in poor condition and should be replaced but the major portion is in fair to good condition.

In order to preserve the equipment on hand in the best possible condition, periodic inspections are made and any necessary adjustments or repairs are made at the time. Very often these minor adjustments and repairs will save a major breakdown and an expensive overhaul that would require a large number of repair parts which, in many cases, are difficult if not impossible to obtain. It is however, becoming increasingly difficult to carry on the "Preventive Maintenance Plan" due to a shortage of competent mechanics.

Since a shortage of manpower in the maintenance organization exists, and desire on the part of the highway department to reduce maintenance expenditures to a minimum, it would at first thought appear that there would be a reduction in the cost of maintaining equipment. This, however, will probably not be the case. A large number of the older experienced operators of this equipment have been called for active military duty, and a number have gone to defense jobs where higher wages are paid than is possible on highway work. Consequently, it has been necessary to employ men inexperienced in both the operation of the equipment and the type of work to be done. As a result, there will be a reduction in the efficiency of the work done. That is, it will take more man hours and more mileage on equipment to do a particular job than it did in the past. Inexperienced operators, particularly on the heavier equipment, will result in increased repair costs.

It is hoped that some arrangements will be made whereby the state highway departments will be able to get enough experienced men to maintain the highway system of the United States without a great loss in the capital investment which the people have made.



Typical of the maintenance centers built by the Wyoming Highway Department is this one at Douglas. It serves both as a storage and repair shop for equipment and as headquarters for the local maintenance staff.

Soft spots that develop in bituminous pavements must be repaired quickly to avoid destruction of the road.

Highway Maintenance During the War

Rex M. Whitton
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***Contents in Brief**—Maintenance of highways in safe operating condition is essential to the nation's war effort. Prompt repair of small defects in roads will avoid serious damage and possibly destruction of surfaces that cannot be replaced at this time. Experienced maintenance men, familiar with the sections they must patrol, are the key to successful maintenance of highways, hence highway departments should be permitted to keep such men.*

THE PRESENT WORLD-WIDE conflict is sometimes referred to as a "war of transportation," for it is acknowledged by all that transportation is playing a most vital part in the war effort. Among the many forms of transportation, highway transportation is recognized as one of great importance. In war, even more than in peace, hghways play a major part in the enormous task of transporting people, food stuffs, raw materials, and finished products.

The efficiency of highway transportation is dependent definitely and materially upon the standard of highway maintenance. If the highway is not kept smooth and open at all times, highway transportation is affected immediately; in other words, the rougher the road, the more tire wear and tire destruction, the more breakdowns in equipment, and the more accidents resulting in property damage, personal injuries, and death. Roadway, structures and highway facilities must be kept as nearly as possible in the original condition, and traffic services such as snow removal, ice control, marking and signing must be continued. If adequate, continuous, skillful, and systematic highway maintenance is not provided, failures in road surface occur, waterways become clogged, shoulders rutted, and general deterioration starts immediately due to the normal wear and pounding of traffic and the stresses that nature places on highways through heat, cold, and storm. The old adage "A stitch in time saves nine" applies to highway maintenance more literally than to any other work.

When maintenance is neglected or curtailed, the road surface immediately becomes rough and holes develop. This results in a dangerous and hazardous condition for traffic, causing serious damage to vehicles.

Rough surface conditions are caused mainly by heavy axle or wheel loads; these are the loads that causes the detrimental effect to the roadway. At a time when there is a definite move to increase loads carried by motor vehicles, and when maintenance is being curtailed due to many reasons, mainly lack of manpower, but in some cases also due to lack of finances and equipment and materials, it is fast becoming evident that the standards of highway maintenance are being lowered by conditions over which we have no control.

It has been definitely proven by field investigations and observations in Missouri that vehicles with heavy axle loadings are the direct and final cause of the action in concrete pavements known as the pumping. Reporting on this subject, a subcommittee of the Highway Research Board said recently that "a large number of heavily loaded trucks, in combination with a susceptible soil

type and water, is the final and most important factor in pumping. The deflection of a slab end is dependent upon the total load passing over a joint or crack at any given time. Thus, the load which governs the amount of the deflection is the axle load regardless of the number and size of the tires carrying the load. The present war effort has resulted in an increase in the number of heavily loaded vehicles, which in turn has increased both the severity of the pumping action and the extent of its occurrence."

If the damage described above is not corrected by maintenance methods or reconstruction, the final result will be the complete destruction of the pavement. There is no doubt regarding this statement as it can be proved to any one by a field inspection of pavements in certain localities in Missouri and other states at this very moment. This condition must, of course, be corrected if highway transportation is expected to play any part in the vital overall transportation necessary to the war effort. Such a breakdown in the pavement may even result in a truck getting stuck in the middle of the road, delaying all traffic on the road seriously.

Deterioration due to weather

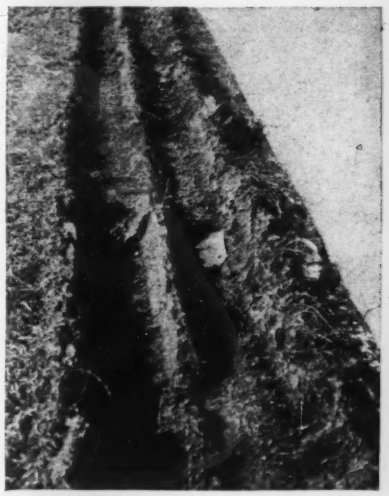
There are many other types of roadway failure caused by traffic, yet the effects of weather and climatic conditions alone without any traffic can, in a relatively short period, result in the complete deterioration of a road surface. This situation has been noticed on portions of highways which have been abandoned due to relocation. Regardless of the type surface on the abandoned section of highway and regardless of the fact that there may not be any traffic on it, the roadway and right-of-way soon becomes in a condition unfit for present-day traffic.

While on the subject of weather, it might be pertinent to call attention to the fact that a large portion of the mileage of the pavements in Missouri was constructed during a climatic cycle of light rainfall. It now appears that the rainfall condition has changed to a period of heavy rainfall. Abnormal rainfall adds to the problem of maintenance and makes it more vital than ever that adequate routine maintenance be provided at all periods during the year.

Snow removal and ice control are among the principal duties of the maintenance organization in many states during the winter months. Upon the successful performance of this work depends the uninterrupted flow of highway traffic and the smooth operation of wartime industry.

Careful planning and an adequate organization are necessary to insure a successful plan of operation. The successful carrying out of the plan, however, depends entirely on the intelligent and efficient work of carefully trained men operating sufficient equipment to cover all roads at the proper time.

Maintenance employees included in the snow removal and ice control organization must be ready to start work at any time—day or night—and must be able to carry on under all conditions on a 12-hr. shift. Ice control work must start when ice begins to form on the roadway surface. Snow removal work starts very shortly after the snow begins to fall; as soon as there is enough on the road surface to be removed with plows. All work continues on a 24-hr. basis until the traveled ways are cleaned of snow. Nothing less than bare pavement is satisfactory in Missouri, as this provides the maximum traffic mobility and safety.



Damage of this kind to shoulders or pavements calls for quick action by experienced road maintenance men.

In this critical period, proper and efficient snow removal work is more important than ever, due to the fact that highly important routes can become entirely blocked with snow. This possibility makes it mandatory that we retain our highly trained operators if at all possible as well as keep our snow removal equipment in tip-top repair.

Road abandonment impracticable

It has been suggested that it might be possible to abandon maintenance entirely on certain highways, but it would be highly difficult if not impossible to decide which highway or portion thereof should be abandoned as all sections of the country are producing commodities or materials that enter into the war effort. Materials and commodities must be transported over the highways, at least for short hauls.

It has been stated that trucks, buses, and private cars are the only means of transportation for citizens living in more than 48,000 communities in the United States which have no railroad facilities. For all citizens, including those living in communities served by railroads, highway transport provides an expedited service suited to the immediate need of shippers and consumers alike. This is also true for the numerous defense areas.

Special skills required

Maintenance is not built into a road; it is a separate and subsequent operation. This will be seen in the accompanying pictures. Vital requirements for adequate highway maintenance are money, men, materials, and machinery. Highway maintenance is not an exact science. The same type of road in different localities often requires different maintenance operations due to soil, rainfall, or other variables; and, consequently, repair methods which give good results at one location may not be the proper methods at another

location. This condition makes it imperative that the maintenance employee, commonly called a patrolman or sectionman, who is responsible for the maintenance of a definite section of highway varying in length from 20 to 50 miles, be a man of excellent judgment and experience in handling men, materials, and the operation of road-maintenance equipment.

The maintenance patrolman is the keystone of a highway maintenance organization. He sometimes works alone, sometimes with a helper, and sometimes with a group of two or more men. The patrolman is removed from the constant supervision of his superiors and must often act on his own initiative. It has been the opinion of many laymen, even among those connected with a highway department, that the average maintenance man, working for an hourly wage, and the full-time patrolman, were merely laborers who could be easily replaced at any time. This may have been true in the early days of highway maintenance, but a careful scrutiny of the present organization will reveal that the systematic maintenance of our highways is carried on by men who, through long years of training and experience, have, to a great extent, become highly skilled in their particular field. It has been our policy in Missouri for a number of years to select our full time patrolmen from the group of laborers, among whom are men who have been employed as such for many years.

Pumping under concrete pavements removes the subgrade support and causes breaks of the kind shown in the upper picture. The lower picture shows a typical beginning of failure in a bituminous pavement due to soft spots. The heavy loads of today aggravate such conditions.

Each patrolman is familiar with every foot of his section of road. He knows every culvert that is undersize and will need attention during rains. He knows where the ditches will fill from washing, rains and floods. He knows where snowdrifts occur in spite of every precaution taken to prevent them. He knows where the spots of ice first form during sleet storms. He knows how to handle his truck and plow in a snowstorm. He knows the people along the road and where he can hire an extra team. He knows how to patch bituminous roads. He knows by experience that bituminous patching must not be too rich nor too lean. He knows how to handle and service various kinds of equipment, including the truck, motor grader, asphalt patching equipment, and other pieces of equipment which may be assigned to him from time to time. He is by no means a poor track-type tractor operator, and can, when needed, operate a pull grader. His training permits him to handle an emergency and direct the efforts of a large group.

In these days of scarcity of equipment and repair parts it is doubly important that capable men have the care of equipment, as one small broken part may mean that maintenance operations cannot be carried on for days and possibly weeks. *The experienced maintenance patrolman cannot be replaced overnight!*

Much the same thing can be said of the men in extra labor crews. They have worked at various times on a variety of highway operations and so have become familiar with our methods of maintenance and are capable of handling various types of equipment. Where to find men to replace these men is hard to say, especially now when the commonest kind of common labor is available. *The experienced highway maintenance man should be kept on highway maintenance.*

Loss of maintenance personnel from the Missouri Highway Department to the armed forces and to war industries already has made necessary a change of maintenance policy from seasonal maintenance to year-around maintenance. For example, it has been the policy in the past to make major repairs to bituminous surfaces almost entirely during the summer months; now it has become necessary to make these repairs throughout the year. Slow delivery of materials, as

well as lack of men, dictated this change of policy.

Materials and machinery are almost as vital as men in providing adequate highway maintenance and, if not available at the time of the need, disastrous results very often occur. Even delays in obtaining material or in obtaining repair parts for machinery ofttimes require the expenditure of money, time, and materials many times the amount which would have been required had the material or machinery been available at the time the need was first determined. For example, the bitumen in a bituminous road surface may become dry and in need of additional bituminous material to enliven the dried out surface. If this additional bituminous material is not placed within a short period, it is possible that the entire bituminous surface may be lost, thus causing an expenditure of money in labor, equipment operation, and materials ten times the amount that would have been necessary at the earlier date.

Materials extremely vital to highway maintenance are bituminous material, portland cement, crushed aggregates, sand, miscellaneous steel, lumber and equipment repair parts. Supplies of these should be made available to the highway departments.

Summarizing, it can be truthfully said that highway transportation is making a worthwhile contribution to the war effort; and, if this highway transportation is to be continued, proper maintenance of the highways must be provided. In order to have proper maintenance, it is necessary to have money, men, materials, and machinery. Highways are absolutely dependent for their existence on the day by day work of highly organized maintenance operations under experienced supervision and control.

Keeping Trucks Rolling In Oregon

E. A. Collier
Maintenance Engineer, Oregon State Highway Department
Salem, Oregon

***Contents in Brief**—Oregon has eased its road oil situation by construction of tanks to store oil as it becomes available. Men lost to war industries and military service have been replaced in part by women. Right-of-way work has been reduced, snow will not be plowed on recreational highways and snow removal and sanding operations are to be curtailed on other roads wherever possible.*

OREGON stands facing the enemy in the Pacific theatre of war. Her forests supply one-sixth of the nation's lumber for docks, barracks, and factories. She provides wool for warmth and beef and wheat for energy for our far flung forces and her shipyards launched thirty boats in November to "pass the ammunition" across the seven seas. Trucks must move these supplies over the highways to the mills, railroads, and seaports.

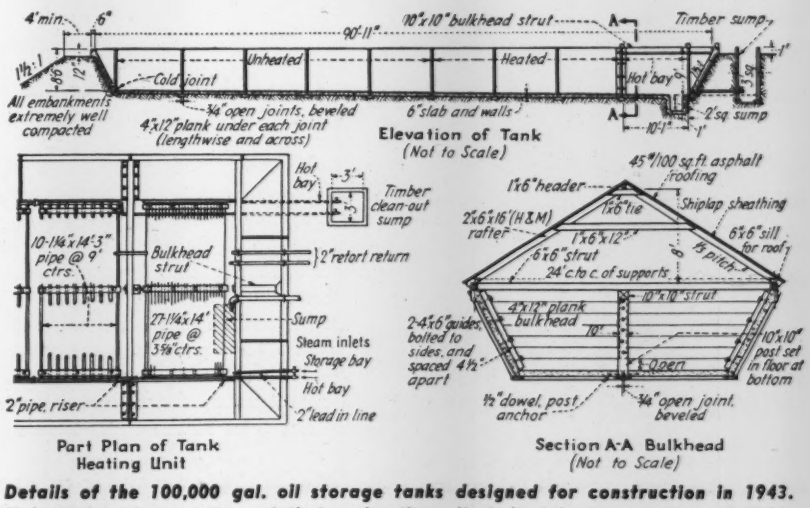
Heavy traffic increased this year, both in numbers and in maximum load per vehicle, and increased maintenance of road surface was required and was provided in spite of many handicaps.

Oil storage plan Developed

Last spring when the road oil shortage appeared probable, a 600,000-gal. tank in Portland was rented and filled, and four 50,000-gal. tanks were constructed of timber at strategic points in Eastern Oregon. These were equipped with heating pipes and filled. Asphalt in barrels for the paving plants was ordered and supplied in advance of the construction season. In addition, a considerable amount of asphalt was supplied in railroad cars during the oiling season. This plan to provide storage to supplement car delivery increased the efficiency of the crews and reduced demurrage and car shortage. It had the great advantage of making it possible to accept delivery when oil and cars were available. Plans have been prepared for 100,000-gal. tanks to be built this year. Details are given in the accompanying drawing.

Costs went up in 1942. Asphalt patching cost $6.86 per ton in place last year as compared with $6.00 per ton in 1941.

The five oiling crews used a total of 3,200,000-gal. of asphalt in resurfacing and nine paving plant crews placed a total of 88,100 tons of



Details of the 100,000 gal. oil storage tanks designed for construction in 1943. It is to be of concrete and timber, heating oils being the only part calling for critical materials. Last year, four 50,000-gal. tanks were built of timber.

asphaltic patching mix, both of which are records for this state. Credit for the fine performance this year rests largely with the loyal, experienced men remaining in these extra gangs. However, it will be a hard job this winter and next spring to keep the dents out of the pavements where the logging trucks roll.

Women used on road work

Many men from these crews have gone to the army and the shipyards. Women took the places of some of them as flagmen, truck drivers, and rollermen. These places were filled very acceptably by members of the fairer sex. They got their hands and faces dirty but did their work well and the morale of the crews was high. Training classes for women truck drivers are planned for next spring. Women doing men's work in the field are paid the same wages. All of the field forces are now working 48 hours per week.

The section crews have also been reduced and it has been necessary to defer certain items of maintenance, such as mowing shoulders, painting guard rails, picking up papers, and trimming trees. It has also been necessary to defer part of the pavement striping. Four striping crews only remain instead of the usual six. Keeping the road surface and bridges safe for heavy traffic has been the first consideration.

Women have been hired for many road jobs and have proved to be satisfactory. They are paid the same rate as for men in the same class of work.

Oregon's patching crews made a record in 1942 by placing 88,100 tons of asphaltic patching mix. This is one of the portable pavement patching plants.

The highway commission decided to defer snow removal on purely recreational highways and have sold two "Snogos" to the Army for use at airfields. Wornout snow plow blades have been welded together to save steel. Reduced personnel will not permit the usual full snow plowing and sanding, but the passes through the mountains will be kept open.

New construction deferred

New construction, except access roads to military camps and shipyards, has been deferred. Some weak sections which should be surfaced under contract in normal times are being maintained as well as can be with the available men and materials. There has been a ten percent drop in receipts from gasoline taxes and a larger drop is expected, but no cuts in maintenance have been or can be permitted on this account. It has been impossible to replace all of the men who have gone into the service and into war industries. At present the maintenance forces are 23 percent less than at the same time last year.

Crushed rock or gravel is essential for the maintenance of surfaces. Contractors have been loaded up with work for military camps and air fields and have been reluctant to bid on highway projects due to the difficulties in getting machinery, repair parts, and tires. Several maintenance-material projects have been advertised three or four times without getting any bids. Supplies of maintenance materials, therefore, are low.

Oregon has had excellent relations with the tire rationing board and has now secured an ODT permit and gasoline rationing books sufficient to operate during the coming year.

Equipment in good shape

Fortunately, the state had a fair supply of good equipment a year ago. The repair and replacement of bridges had been pushed during the past several years so that most of them are in good condition for the increased loads they must carry. There have been delays in securing lumber for bridges and repair parts for equipment but the lumber restrictions are easing off and quicker action is now being secured on the release of this essential commodity.

The slogan of the maintenance department of this state is "Keep 'em Rolling." This is a war for survival and all citizens must do their part. The part required of the maintenance forces of Oregon is to keep the vital highway transportation ways in good condition, in spite of the manifold difficulties in a war economy.

Virginia Roads Put on War Basis

J. J. Forrer
Maintenanee Engineer, Virginia Department of Highways
Richmond, Va.

CONDITIONS BROUGHT ABOUT by the war have greatly affected maintenance operations in Virginia. Over 1,000 highway maintenance employees have left for other services, and reductions in income from gasoline and motor-vehicle taxes have made necessary cuts of $2,300,000 in expenditures on the secondary road system and $1,200,000 on the primary system.

It being practically impossible to replace the lost employees, Virginia has adopted a policy of combining the maintenance areas and forces, eliminating the patrol system and establishing the unit-area system of maintenance in its place in defense areas where the shortage of manpower is critical.

The fact that traffic has declined due to gasoline and tire rationing, however, does not relieve entirely the burden on the maintenance division. Some maintenance operations always are necessary to preserve the state's enormous investment in its highways. Also, in order to keep roads open during snow and ice storms, during floods and other emergency conditions, field operations cannot be entirely dispensed with. And even in ordinary weather, rain will bring about bad drainage conditions and cause damage to surfaces which cannot be neglected.

Use of equipment

Because it is impossible to secure new equipment, the department is working on the basis that the present equipment will have to be operated for duration. Repair parts are becoming scarce and mechanics to repair equipment are very few. Consequently, instructions have been issued to use equipment with extreme care, not only to save the equipment but also to conserve tires and gasoline. Mileage traveled must be kept to a minimum, loads reduced to save tire wear, and equipment so operated as to prevent unnecessary strain. In snow removal work, for example, instructions have been issued to operate blades one inch above the pavement surface. This requires less power and saves blades. Operators are not permitted to buck equipment into drifts.

Where heavy snow drifts are encountered in which a single piece of equipment might get stuck, the crews are instructed to plow to one side if possible, calling for heavier equipment from district headquarters if that appears necessary. Each district headquarters keeps reserve equipment to be sent out only when needed to handle emergency conditions and for replacement of broken-down equipment. Resident engineers are given a record of the reserve plows, but are not to call for help before conditions actually warrant such action.

Snow removal curtailed

Snow is pushed only far enough to allow free passage of traffic. Main roads are to be opened to full width. Routes carrying products of large dairies and other food products are to be kept open if possible, plowing one-way lanes with frequent passing places during heavy storms. Resident engineers have been told to determine from school superintendents and mail carriers which are the most important routes to be kept open under conditions in which all roads cannot be kept open. The engineers also are to build V-type pull plows to help farmers keep roads open that cannot be kept open under restricted operations. When possible, plows will be run through these roads to level the compacted snow and fill holes.

In all towns of 3,500 population or less, snow will be cleaned from streets on the state highway system to a width of 24 ft., the snow to be piled on each side. In larger towns, arrangements may be made to remove snow from a 24-ft. width at the town's expense.

Frequent machining of roads of minor importance is to be abandoned, going back to the old county method of machining and dragging once or twice a year. Mud holes that develop in these roads are to be drained and filled with stabilized materials.

Mowing operations during the past season were limited to about half that of previous years. However, as the season drew to a close it was found that where shoulders were not mowed, thick grass prevented proper drainage from the surface and through ditches. As such lack of adequate drainage is detrimental to the roadway, this year's mowing operations will not be so severely curtailed.

Instructions have been issued against neglecting drainage under any circumstances, especially along hard-surfaced roads. Where necessary, ditches are to be deepened. Landscaping also must be preserved as far as possible, especially that designed to control erosion in cuts and on fills. Such work will prevent future excessive maintenance costs.

Maintenance of surfaces

Maintenance forces are required to patch surface breaks as soon as they are discovered, recognizing that as bituminous materials are scarce, they must be sparingly used. Checked places are to be sealed before the surface materials become displaced. This saves patching. As there appears to be no great scarcity of cement, concrete patches may be necessary, even on bituminous type pavement.

Surface treatments in the future are to be limited to the seal type, just sufficient bituminous material being used to seal the road so as to preserve the original investment. Sand, being a less costly covering material, is to be used for this work as far as possible to keep down highway expenditures. No new treatments are to be applied on secondary roads except those being used for war purposes. It may be found necessary to let some secondary roads revert to the earth type.

Marking of traffic lanes on roads carrying less than 600 vehicles per day already has been eliminated. As traffic declines, more of such work may be dropped.

Fig. 1. Three-level crossings are required to separate through traffic from traffic flowing to and from the bomber plant.

Michigan Builds War Roads

***Contents in Brief**—In the fall of 1941 Michigan began construction of access roads to serve the projected Willow Run bomber plant and now is building a 16-mile expressway to give that plant and the Ford plants at River Rouge better connections to Detroit. The new divided highway has four lanes of unreinforced concrete. All intersections are separated on the expressway, two three-level separations being included near the bomber plant. Limitations on steel and soft ground under some structures introduced unusual structural problems.*

CONSTRUCTION of a superhighway to connect Detroit with two great centers of war activity to the West, Ford's River Rouge plant and the new Willow Run bomber plant, is being pushed actively by the Michigan State Highway Department. Known as the Detroit Industrial Expressway, the new highway will extend 16.1 mi. in a southwesterly direction from the city line near the intersection of Ford Road and Michigan Ave., past Dearborn to a point near Romulus, southwest of Wayne, where it will intersect the southerly access road to the Willow Run plant. Ultimately, this 16-mile section is to serve as part of a superhighway from Detroit to Chicago. It is Michigan's first limited-access road, legislation authorizing construction of such roads having been passed in 1941.

Anticipating an unprecedented need for highways to serve the great bomber plant at Willow Run, G. Donald Kennedy, head of the Michigan Highway Department, made applications in the summer of 1941 for approval of a four-lane divided highway along three sides of the site selected for the Willow Run plant. These applications were approved before the Defense Highway Act of 1941 was passed, and as most of the work was to be off the federal-aid system, funds for the federal government's share of the work were obtained from funds allocated to defense public works.

The only state route serving the plant site at that time was Ecorse Road, which runs close to the north side. As this road could not be widened except at excessive cost, a parallel four-lane divided highway was built to the south of Ecorse Road, between that road and the plant site. This will permit existing Ecorse Road to be used as a service road, thus minimizing encroachments on the new road, which was started before the limited-access act of 1941 was passed.

Wiard Road to the west of the plant site and Chase Road to the south are county roads of inadequate capacity. They have been replaced by four-lane divided highways lying partly in Washtenaw County and partly in Wayne County. Engineering work on Wiard Road was done by the state highway department and work on Chase Road to the south of the county line was done by Wayne County. It got 75 per cent federal aid and Washtenaw County got 100 per cent. Access rights to Chase Road from the south are now being acquired by negotiation wherever possible, otherwise by condemnation. Ultimately a service road will be built for about one-half the length of the new highway.

Program expanded

As study of the anticipated flow of traffic to the bomber plant progressed, plans for the access roads were expanded to include connections from the four-lane belt-line highway to main highways near the plant, including construction of part of what ultimately will serve as a by-pass road to the east and south of Ypsilanti. To give free flow for traffic from these main highways and the belt highway to and from the plant, two three-level

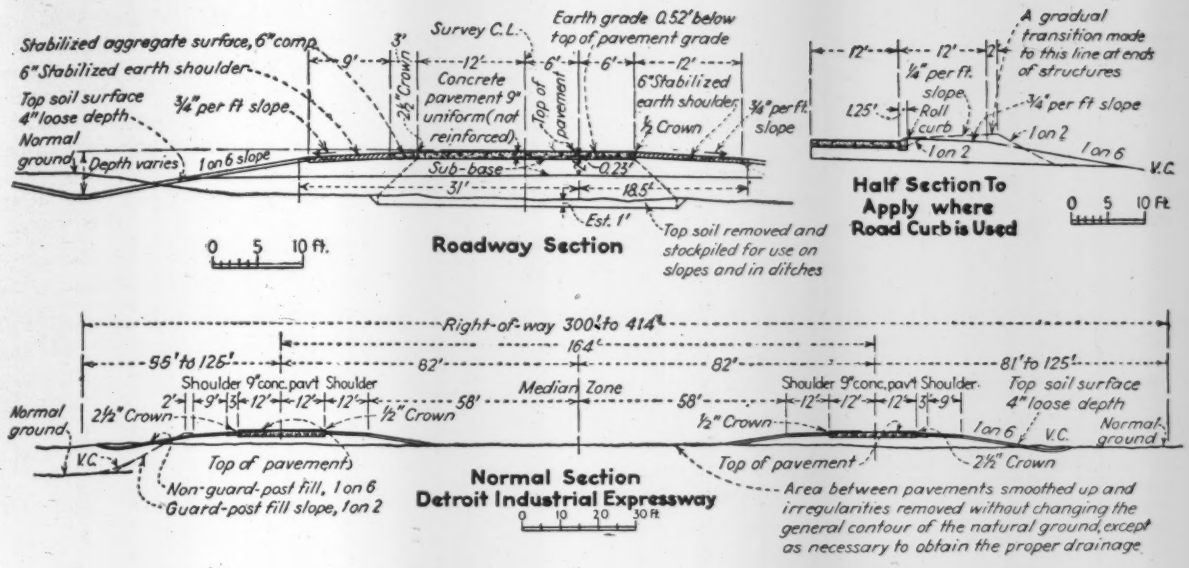


Fig. 2. For the greater part of its length, the section of the Detroit Industrial Expressway that is now under construction will be raised slightly above the level of the surrounding country, which is generally flat. The highway initially will have four lanes, each pair separated by a wide median zone on a right-of-way having a minimum width of 300 ft. Provision is made for adding two more lanes.

grade separations were constructed and four two-level separations. Also, one of the four-lane highways had to be carried under the main line of the Michigan Central and crossings had to be provided over rail lines into the plant.

Connections are made to Ecorse Road, running east toward River Rouge and west into Ypsilanti, also to U. S. Route 112 east of Ypsilanti. Recently, approval was given for an extension of the access road system to a connection with U. S. 112 west of Ypsilanti, thus forming a by-pass around that city and taking much of the traffic to the bomber plant off its streets. Contracts for this work were let in December, 1942.

Colored concrete used

To facilitate the segregation of traffic flowing to the bomber plant from the through traffic at interchange points, lanes of the Willow Run Expressway system that lead to plant access roads are colored black. Coloring of the concrete is begun sufficiently in advance of the turning point to permit plant-bound traffic to shift over onto the dark lane without impeding the flow of through traffic.

Similarly, on the Detroit Expressway, black concrete is being used on deceleration lanes at interchange points and for acceleration lanes at entrances to the expressway.

Grading and paving of the highways serving the bomber plant were begun in the fall of 1941 and were carried forward through winter months when Michigan normally shuts down paving work. As a result these highways are nearing completion. Construction of some of the bridges and grade separation structures also was started in 1941 but priorities delayed that work.

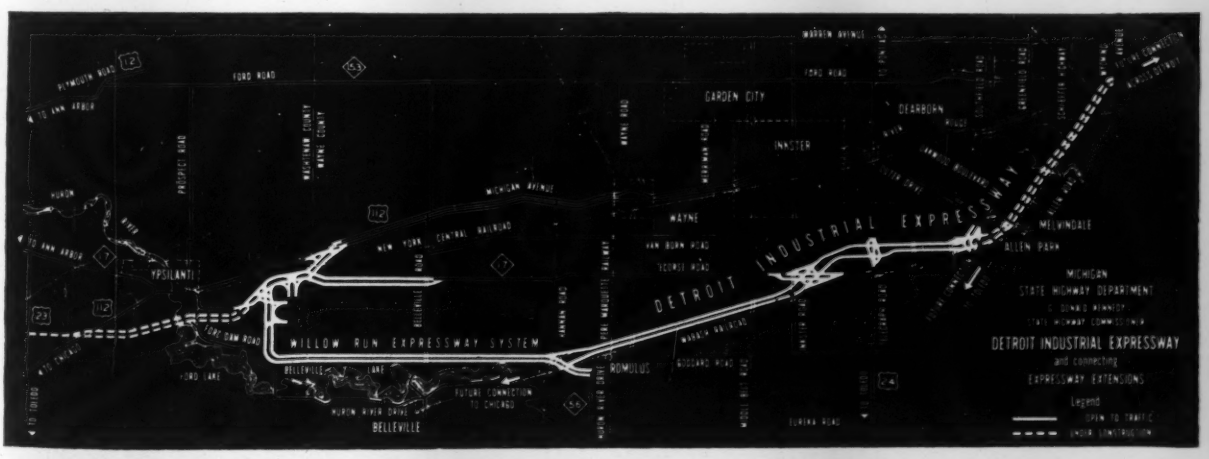


Fig. 3. The Detroit Industrial Expressway ultimately will form part of a superhighway between Detroit and Chicago. It is being built at this time to speed motor traffic between the war industries in the region west of Detroit. The Willow Run Expressway connects this highway with the Ypsilanti region and also will serve as a by-pass for that city on U. S. Route 112.

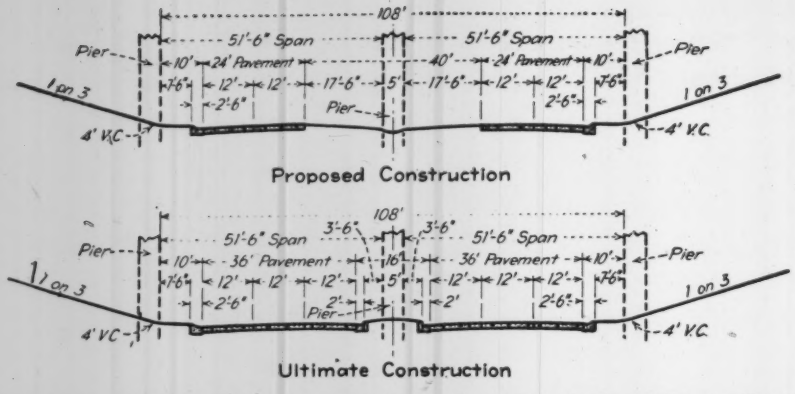


Fig. 4. From Greenfield Road to the city limits of Detroit the highway will be depressed as such construction will simplify work at the many grade separations and will eliminate much filling, which is costly in the Detroit region. Four lanes will be built initially, with provision for two more when required.

To save steel, the pavement was built as an unreinforced concrete slab, 9 in. thick, without center-joint dowels and with no steel in the expansion joints. Two 11-ft. lanes are used for traffic in each direction, lanes being crowned $1\frac{3}{8}$ in. Widening to three lanes, as is contemplated for the expressway, is not planned for on the access roads.

Expressway planning

When construction of the Detroit Industrial Expressway was first contemplated as a means for speeding war-industry traffic, the highway department planned to build first the section within the Detroit city limits. Hence that part was designated as Section 1. However, obstacles arose

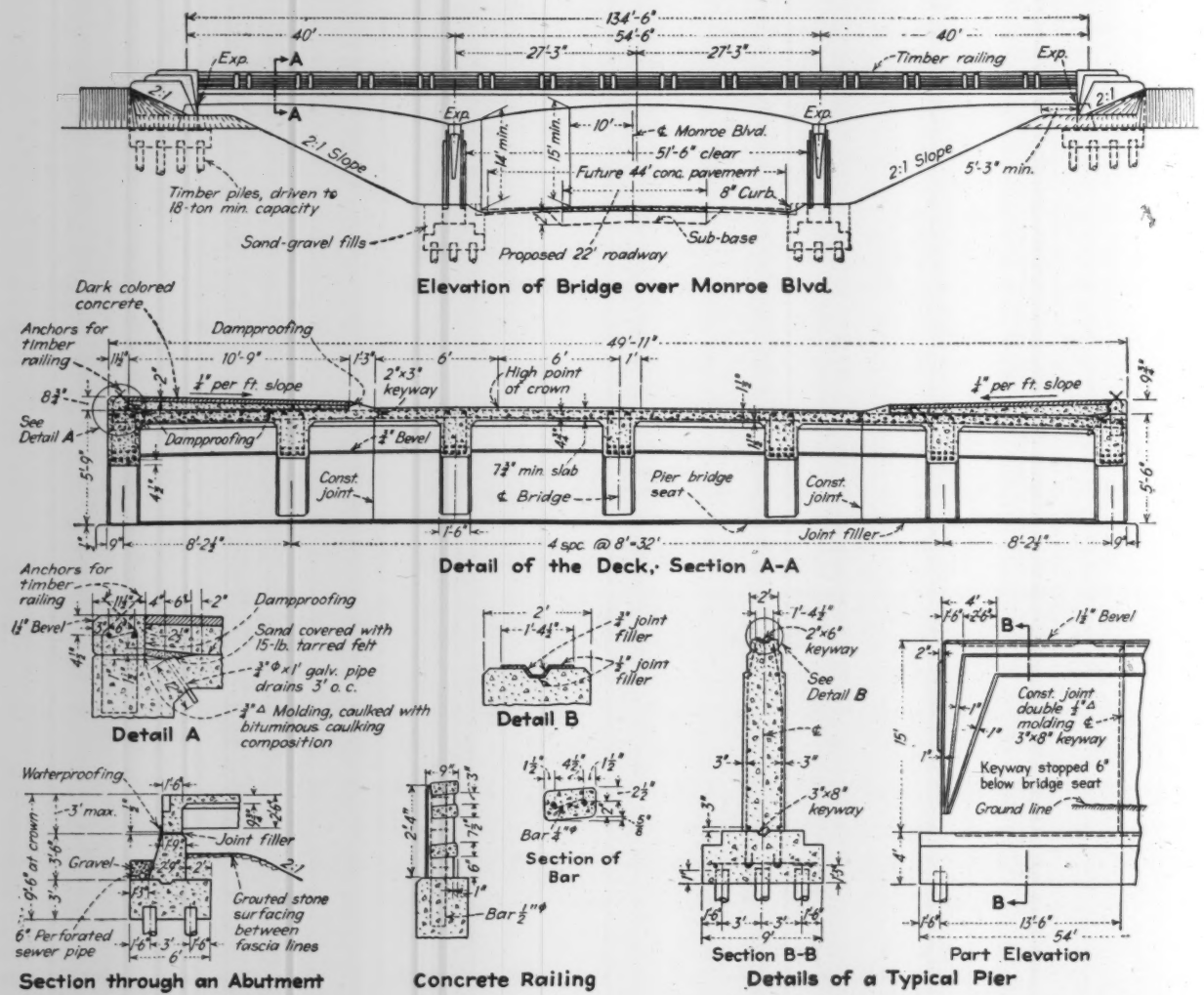


Fig. 5. Superstructures at the grade separations are very similar. Foundations vary due to varying soil conditions. Girders are of reinforced concrete, except in the three-level structures and the Michigan Central crossing. Reinforced concrete is used in piers and abutments. Railing for structures are of reinforced concrete. Notable is inclusion of the full shoulder width in the bridge decks. Concrete on the shoulder extensions is given a dark color.

to a quick start on that section, and as a result, Section 2 was the first to receive certification from the War Department as essential to the war program. It is at the bomber plant end of the expressway and runs from the easterly end of the new work along Chase Road to Southfield Road, south of Dearborn. Section 2 now is nearing completion.

More recently, Section 3, running from that point through the River Rouge industrial area to the city line at Wyoming Ave., near the present intersection of McGraw and Michigan avenues, was approved. In all, 16.1 miles of the industrial expressway costing nearly $12,000,000 now have been approved. The first certification was received in February, 1942. Up to the end of October, contracts totaling approximately $4,500,000 have been approved. The federal government, under the Defense Highway Act, will pay 75 per cent of the cost other than for right-of-way, which will be paid for by the state.

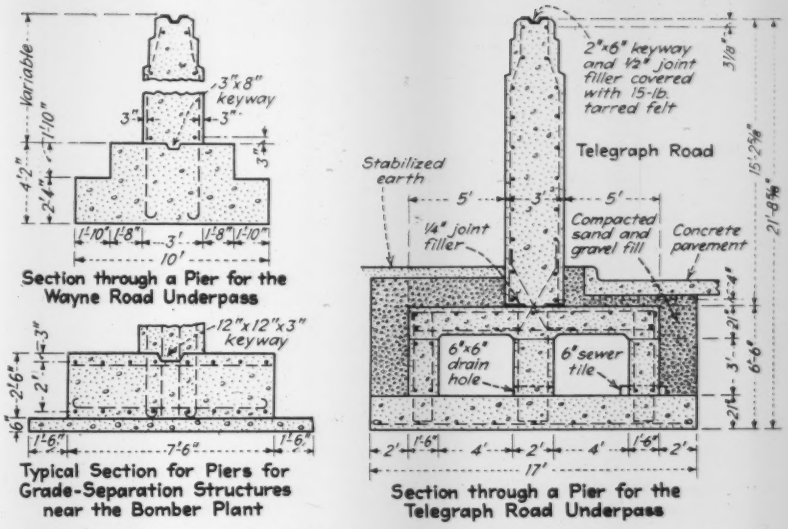

Variable
3"x8" keyway
Section through a Pier for the Wayne Road Underpass
12"x12"x3" keyway
Typical Section for Piers for Grade-Separation Structures near the Bomber Plant
2"x6" keyway and ½" joint filler covered with 15-lb. tarred felt
Telegraph Road
Stabilized earth
¼" joint filler
Compacted sand and gravel fill
Concrete pavement
6"x6" drain hole
6" sewer tile
Section through a Pier for the Telegraph Road Underpass

Fig. 6. Three types of foundations are here shown as developed to meet varying soil conditions. The design used at Telegraph Road is notable. Where piles are required, the design shown in Fig. 15 is used.

Designed for six lanes

Initially, the expressway is being built as a four-lane divided highway; ultimately two more lanes will be added. Median zone widths vary from a minimum of 140 ft. to 800 ft. at some interchange points. Right-of-way width also varies widely, the minimum being 300 ft.

All intersections are separated and in the final layout all roads entering or leaving will be laid out for directional interchange. Temporarily, a cloverleaf intersection is being built at the Middle Belt Road intersection. Access to the expressway is limited; at a few points it will be necessary to build service roads.

The grade of the new road has been set slightly above the level of the surrounding country, chiefly to facilitate drainage, but also to reduce gradients on the expressway and the depth of cut at underpasses. In the grading, topsoil is being excavated to a depth of about one foot in advance of filling and is stockpiled for use on slopes and in ditches.

Standards of the American Association of State Highway Officials are used generally in the design of this expressway. Design speeds are assumed at a maximum of 100 mph., maximum curvature is 1 deg. 30 min., and maximum grades, 2 percent. Sight distances are practically unlimited on the open road. Ramps at the directional interchanges are superelevated for 40 mph. and the sharpest curves at these intersections have a 250 ft. radius. All structures are designed for H-20 loading.

Roadway design

Details of the roadway are given in Fig. 2. Because addition of two more lanes is contemplated, the pavement is crowned from the center of the inside lane in each roadway. As noted previously, the pavement is a slab of unreinforced concrete 9 in. uniform thickness. Expansion joints are spaced 120 ft. apart and planes of weakness are introduced at 20 ft. intervals by insertion of a thin bituminous filler in the upper two inches of the pavement. No load transfer devices are used at the expansion joints. These joints are simply a 1-in. asphalt-impregnated fiber filler, set low and capped with bituminous mastic.

Fig. 7. Concrete paving for the new road is an unreinforced slab of uniform 9-in. thickness. No load-transfer devices or other metal are used in this pavement.

Longitudinal center joints have no dowels, keyways being formed in the concrete as placed. Thus all steel has been eliminated from the pavement as a war measure.

Culverts are of unreinforced concrete pipe, except where reinforced pipe still is available, or of extra-strength tile pipe.

Grade separation structures

Grade separation structures, generally, are of reinforced concrete. Exceptions are the Michigan Central railroad underpass and the three-level crossings on the Willow Run Expressway. In these structures, steel girders were specified for the long spans that were necessary. Getting steel for these structures, some of which were designed in 1941 before steel became so critical, proved to be a problem that delayed completion of work at the bomber plant considerably. The three level crossings now are substantially completed, but steel for the Michigan Central underpass still has not been received. To cut down the steel required, that structure was redesigned in 1942. The concrete trough deck to carry the tracks was eliminated, an open deck being substituted to save weight, and timber bents were substituted for steel and concrete in the approaches, thus making steel girders necessary only for the main spans over the highway.

Details of a typical grade separation structure are given in Fig. 5. Of architectural interest is the V motif in the side view of abutments and piers and the end view of the piers.

Evolution in pier design

Designs for the piers show considerable evolution since the first designs were made for structures at the bomber plant. Initially it was proposed to use unreinforced concrete to save steel, but a study of the effect on the thin piers of expansion in the girders indicated that tension would be set up in the faces of the piers under certain conditions. As a result, reinforcing was added, the design being similar to that shown in Fig. 5. However, it was soon realized that while this design would be satisfactory for the ground conditions at the bomber plant it would not be satisfactory for the softer ground conditions nearer Detroit because expansion movements in that design tend to rock the whole pier about the outer edges of footings, thus tending to work them into the ground. Consequently, the design shown at the right in Fig. 6 was developed. As will be seen, this allows for a small amount of rocking at the base of the pedestal.

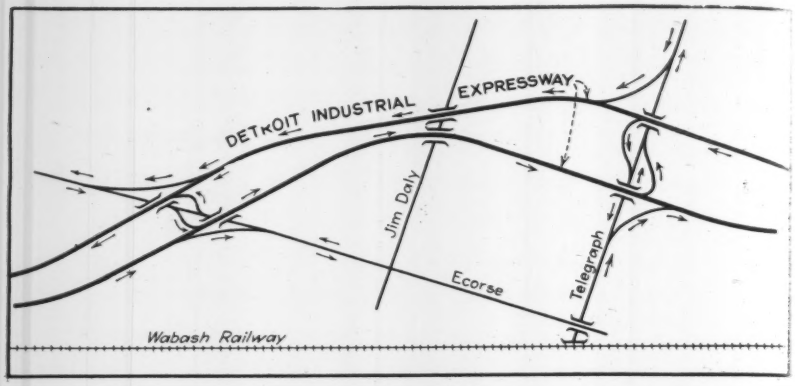


Fig. 8. Directional interchange is provided at all permanent grade separations. One cloverleaf intersection is being built at Middle Belt Road to meet temporary conditions. Here shown are the intersections with Ecorse Road and Telegraph Road. See Fig. 3 for the general location.

Foundation conditions for structures near the Willow Run plant were quite satisfactory, the underlying soil being sand and gravel over hard clay. For all but a few structures founded on natural soil, spread footings of a normal design were used.

Piles were used under abutments seated in new fills. Pile loadings are figured at 18 tons per pile.

Deep pile foundations

East of the bomber plant, soil conditions get less satisfactory as Detroit is approached. Generally, the materials range from surface loam through sand and sandy clays of moderate bearing value to a deep bed of soft blue clay overlying hard sand or ledge rock. If adequate bearing cannot be obtained in the materials near the surface, piles must be driven to the hard sand or ledge as the blue clay provides insufficient friction value for piles. As the clay bed is very deep at many points, pile foundations are costly. Those at Monroe Blvd., Fig. 5, have piles 74 ft. long.

Footings for the Wayne Road underpass shown in Fig. 6 are on a firm blue clay with pebbles; those for the bomber plant structure are on fine sand over firm blue clay. At Telegraph Road the footings are in a firm blue clay which is sandy and stony over soft blue clay in a bed 73 ft. deep to the hard sand and ledge rock. To avoid the use of piles at that point, the box type footing shown in Fig. 6 was developed. Being hollow, its weight is about equal to the displaced soil. It gives a load distribution of 2,000 lb. per sq. ft. A bearing test at that point made since the foundation soil was exposed was run up to 5,500 lb. per sq.ft. without appreciable settlement.

Direction of the work

Construction of these highways is under the general direction of G. Donald Kennedy, state highway commissioner, Harry C. Coons is deputy commissioner and chief engineer. J. G. Schaub is assistant chief engineer. L. W. Millard is bridge engineer; J. H. Flynn, assistant bridge engineer, and A. F. Malo is road engineer. Project engineers at the Willow Run area include H. J. Brighton, A. W. Kirchoff, W. D. Theeringer, C. B. Laird, and K. L. Baguley. Bridge project engineers are Paul Ueberhorst and A. J. Rousseau.

Road contractors include Bridgeport Core Sand Co., Thomas McNally, Gargaro Co., Oak Construction Co., Lewis & Freisinger, E. B. Schwaderer, Julius Porath & Son, Thomas E. Currie Co., Denton Construction Co., Edward Closser, Taylor Brothers Company, Ray Sablain, Louis Garavaglia & Son, Loselle Construction Co., Chas. J. Rogers, Inc., J. W. Hobeck. Bridge work on the projects is being done by F. C. Atletwed, Peninsular Construction Co., Walter A. Toebe & Co., E. J. Vander Veen, E. C. Nolan & Son, Andrew T. Barnes, American Bridge Co., Bethlehem Steel Co., D. T. Frank, W. J. Storen Co., L. A. Davidson, John Hertel, L. W. Lamb, and Getman Brothers.

This listing does not include contractors on the new work at Ypsilanti.

ALCAN—AMERICA'S GLORY ROAD

Part III—Construction Tactics

Harold W. Richardson
Western Editor, Engineering News-Record

CONSTRUCTION of the Alcan Highway is largely a problem of organization and supply. Actual construction operations are relatively simple, especially in building and improving the army pioneer road. Because this phase of the project moved so fast very little time was spent in any one locality, and a special road building technique based on speed, and speed alone, was developed.

The army used seven regiments of engineer troops, three of them colored, to attack the pioneer road at six different points. Following close behind were 54 contractors, including 13 Canadian firms, working under the supervision of four managing contractors, all under the direction of the U. S. Public Roads Administration. These contractors, as noted previously, were at first assigned to build the final-type or permanent road to high-class specifications, following the pioneer route as closely as possible. Early in August, however, plans were changed to shift the contractors over to improving the pioneer road, along with the troops who dropped back to this work as soon as they had completed smashing through a trail road. The combined efforts resulted in completion of the pioneer road as a passable truck route, graveled the full length, from 18 to 24 ft. wide, by Nov. 20. Since that date the road has been in use hauling military supplies.

This is the third and concluding article of the Alcan Highway series. Part I, which appeared in the Dec. 17 issue, told of the purpose of the project and described route location. Part II, covering the problems of supply, equipment and living conditions, was published in the Dec. 31 issue.

The first troops to arrive on the project, the 35th Engineer Regiment, landed by rail at Dawson Creek on March 10. This regiment had the most hectic time of all, as it was important to get these troops into an inland point, Ft. Nelson, 325 miles beyond Dawson Creek, over a winter trail across the muskeg, passable only when frozen, in order that they might start building the road to the west toward Watson Lake. Because Ft. Nelson was inaccessible after the winter trail broke up under spring thaws, getting the 35th in was the key to completion of the whole project in one season.

In addition to its regular army engineer equipment, the 35th received 23 cars of supplemental equipment shipped as a trainload out of Peoria, Ill., which arrived at Dawson Creek about the same time as its own outfit.

Contractors were shifted onto the army pioneer road early in August to help the regiments get the route ready for winter traffic. This is a particularly heavy section near Ft. Nelson.

One of 200 temporary bridges on the Alcan Highway, built in a hurry to carry heavy loads.

Getting all this stuff unloaded and on the road to Ft. Nelson was quite a job.

There was no bridge at all across the Peace River at that time. In order to preserve the ice the engineers planked a road across the ice and covered it well with sawdust. Then the long trek overland started for Ft. Nelson. The temperature ranged from 35 to 47 deg. below zero. The outfit was moved a company at a time, with rations sent ahead in each case so as to be sure food was available for each company as it arrived. The toughest part of the whole job was driving the big tractors and graders, all without adequate cab protection.

There were many wrecks and mishaps, but in spite of it all the last of the equipment was wheeled into Ft. Nelson on April 5. The road went out of service because of a spring thaw on April 17. Rations to last four months were included in the supplies.

Heavy rains and extremely bad weather kept the unit pretty well bottled up near Ft. Nelson until the latter part of June, after which it broke loose and averaged 3 miles per day, traversing some of the toughest country of the entire project, including 160 miles of Rocky Mountains. Two narrow passes, occupied by Summit Lake (El. 4212, highest point enroute) and Muncho Lake had to be crossed. On Sept. 26, the 35th met the 340th Regiment, working east, at a point 305 miles west of Ft. Nelson, east of Watson Lake—305 miles of tough going in three months actual working time. Then the men dropped back to improve the pioneer road.

The 35th had the following equipment, typical of each of the army units: Twenty heavy diesel tractors and bulldozers; twenty-four light gas tractors and bulldozers; six pulled road graders; three patrol graders; six rooter plows; and six 12-yd. carrying scrapers. Also they had ninety-three ½-ton dump trucks, a 6-ton prime mover truck, seven 4-ton cargo trucks and nine 2½-ton cargo trucks, twenty-five jeeps, ten command cars, one sedan, twelve ¾-yd. pickup trucks, a truck crane, and two ½-yd. shovels. All of this equipment was new. Pontons were also included as heavy equipment.

Route of the Alcan Highway and its supply lines. The connection from Haines is now under construction to relieve the load on the W. P. & Y. R. R.

Smaller equipment included portable electric generating units, a ½-yd. concrete mixer, a 315-ft. portable compressor, 8 small portable compressors, 6 plows, 24 gas-driven saws, 2 portable electric welding machines, and several drop pile hammers.

The second regiment to pull into Dawson Creek was the 341st, arriving in April and moving immediately to Ft. St. John over the existing road. Its equipment did not arrive until June, however, so it did not accomplish much until after the June rains and floods. Because the heavy rains made mire out of the low-lying ground to the west of Charlie Lake where new construction started, this unit ferried men, supplies and equipment on ponton barges the full length of the lake to get started at the north end of the lake on higher ground. During these ferrying operations the greatest tragedy of Alcan construction occurred—sinking of a barge with loss of two officers and ten men.

After the rains subsided the 341st backed up and completed the first 18 miles skipped by the jump across Charlie Lake. This unit drove the pioneer road through to Ft. Nelson, 265 miles from Ft. St. John, arriving there Aug. 24. Upon reaching its objective this regiment kept right on going, improving the pioneer road built by the 35th.

The 95th Regiment of colored troops arrived in Ft. St. John in June and followed the 341st, widening the clearing and the road, shaping and grading up, building culverts and bridges, and improving

the pioneer road in general. Besides several smaller bridges, the 95th built one major temporary bridge across the Sikanni Chief River.

Three regiments through Skagway

Meanwhile three regiments arrived in Skagway, Alaska, in April, traveling up the West Coast. One, the 18th, soon went over the narrow gage railroad to Whitehorse, arriving there April 29. The other two, the 93rd (colored) and the 340th, remained in Skagway until June awaiting their equipment. While stationed in Skagway these two regiments found enough equipment to give them some roadbuilding experience in rebuilding the streets of the city. Also they did considerable work on the railroad, which the army later took over under a lease.

The 93rd got out of Skagway first, shipping its equipment to Carcross by rail. From this point the troops started building road to the southeast, though a few companies were detailed at first to improve the 45-mile existing road between Carcross and Whitehorse. Hard going was encountered by the 93rd in building the 100-mile section from Carcross to Lake Teslin through swampy ground and mountains. Upon reaching Lake Teslin the regiment split, part of it dropping back to improve its own pioneer road, the rest jumping across Nisutlin Bay, an arm of the lake, to improve the road built beyond that point by the 340th.

When the 340th equipment arrived it was shipped to Whitehorse by rail, and thence by boat through devious waterways to Morley Bay on Lake Teslin. One battalion went with the equipment, the other battalion hiking overland to Morley Bay. From this latter point the troops worked both ways, east and west. It was only 7 miles back to Misutlin Bay, one of the major water barriers of the entire route, 2400 ft. wide. Going the other direction, the 340th made 219 miles from June 9 to Sept. 24, when it met the 35th east of Watson Lake.

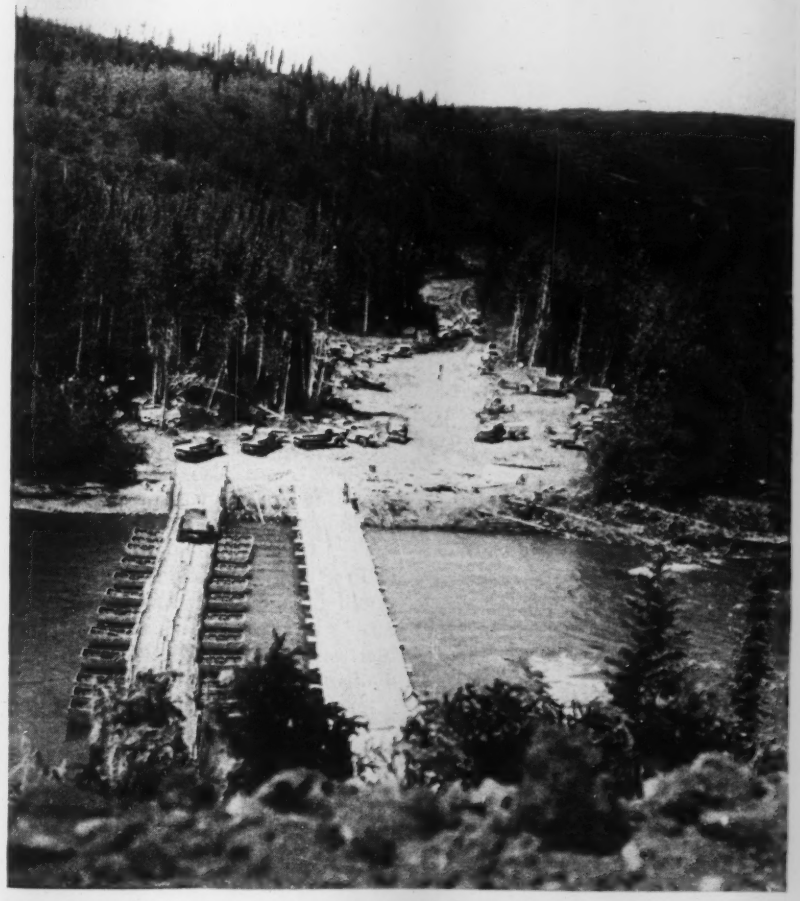
The 340th was one of the best organized of all the regiments, especially from an engineering standpoint. Its operations section established a field engineering office wherever it was camped, complete with drafting room and reproduction machines housed in a tent. The section kept accurate records of the type of ground traversed, footage of corduroy, and plotted its pioneer route from traverse and level lines. In following the Morley and Swift Rivers to the divide between the Yukon and Mackenzie basin, much swampy ground was crossed. In this 80-mile stretch records show that the road was built across 71,640 ft. of wet ground (17.0 percent of the distance) requiring 37,469 ft. of corduroy (8.8 percent).

Upon meeting the 35th Regiment, the 340th dropped back to work on the eastern portion of its pioneer road, building bridges across the Swift, Rancheria, upper Liard and Hyland Rivers, as well as structures across many smaller streams.

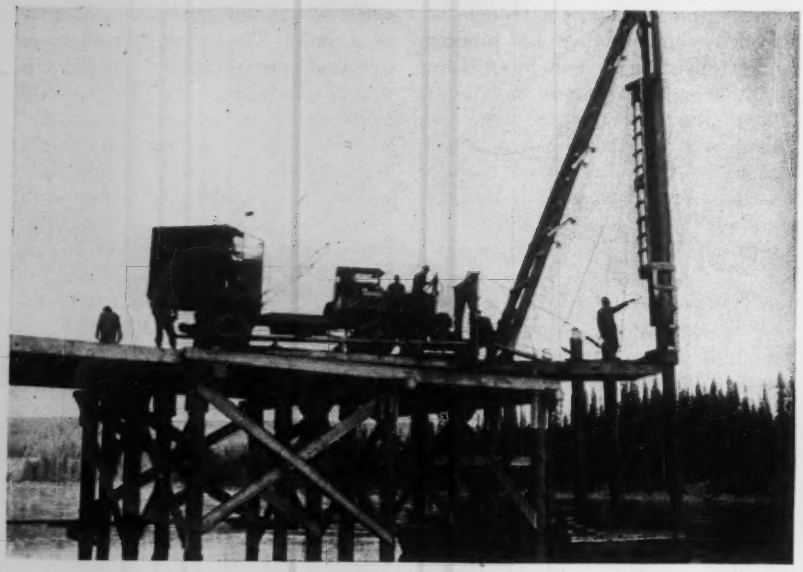
The commander of the 18th Regiment, which reached Whitehorse in April, had planned to split his unit, sending one battalion ahead to the west over a winter trail to Kluane Lake, the other to start working west from Whitehorse. However, the winter trail broke up too soon for this move, so the regiment stuck together as a unit. The most difficult construction these troops encountered was roadbuilding over the perpetually frozen ground of the Yukon and crossing the glacier streams of the St. Elias range foothills, whose wide valleys are completely filled with glacial debris.

The 18th took its regimental band along, which did much to bolster up the morale of the troops and to relieve the monotony of work. Hearing this band play in the Arctic dusk, standing in deep snow in a spruce forest while the soldiers filed past an open field kitchen for their evening mess, was one of the greatest thrills the author experienced on the entire Alcan trip.

The last regiment attacked the road through Alaska, working down into the Yukon. It arrived at Valdez on April 3 and spent six weeks there and at work improving the existing Richardson Highway between Valdez and Gulkana. Then it jumped over



Army ponton bridge served for crossing Yukon's Swift River until a pile trestle could be built alongside.



Army truck crane converted to skid piledriver builds the bridge at the upper crossing of the Liard. Front-end winches skidded the rig around. The drop hammer was handled by the crane load line. Right, Contractor on the Tanana River Bridge at Big Delta used a crawler crane and swinging leads for driving piles with a drop hammer.

a branch of this road to Slana and started north out of there building the pioneer road toward Tanacross, where the Tok River joins the Tanana, on July 1. This regiment, the 97th (colored) had some pretty hard going from the first. It started right out in the Wrangell Mountains, and in the first 10 days made only one mile total progress. During the next 10 days it made 3 miles, which was still mighty discouraging as the schedule called for at least 2 miles a day. However, as the troops became more experienced and hardened, progress became better, though the country didn't. Following up the Slana to Mentasta Lake Pass in the Nutzotin Mountains, then down the Little Tok and Tok Rivers, they reached the Tanana River near Tanacross, 78 miles from Slana, on Aug. 25. Turning up the Tanana, they made much faster progress, and exactly two months later they met the 18th coming up from Whitehorse at Beaver Creek, in the Yukon east of the Alaska border, 195 miles from Slana.

Army construction procedure

The above paragraphs show how the army units were filtered into the project. Their construction procedures were, for the most part, the same although details varied with the ideas of each commanding officer.

The actual location of the road was made by stereoscopic examination of aerial photos, followed in the field by reconnaissance on foot. However, not all of the route was flown in advance of actual construction of the trail road, sometimes all the commanding officer knew was the general direction he was to follow; he had to do his own locating on the spot.

Planes were indispensable in laying out, also in building the project. The aerial photos were made from a standard army photographic plane, but for the most part the planes used in aerial reconnaissance were the small, single-motor "bush hoppers", piloted by local men who knew the country. These planes, fitted with skis for landing on snow or ice, and with pontoons for landing on water when the ice went out, were in constant use.

Planes were also used to carry crews for building temporary bridges ahead of trail construction. In one instance, when a commanding officer realized supply lines to the head crew would be difficult to maintain in a certain location, rations, supplies and fuel were flown ahead, cached along the banks of lakes and streams, waiting for the advance crew to arrive.

Sometimes it was necessary to sustain the foot survey and reconnaissance parties by horse pack train. A few isolated parties kept in touch with their headquarters through signal corps "walkie-talkie" radio sets, but all were equipped with larger radio sets mounted in jeeps or trucks.

As location on the ground was determined, a centerline was blazed ahead by the officers in charge. Speed was the first consideration, so the trail was carried around soft spots that would have taken more time to go across, looped around ravines that would have meant another bridge to build and detoured into open stretches that meant less clearing. Such instances account for much of the crookedness of the route.

Trees easy to knock down

Close behind, sometimes too close for comfort, came the lead bulldozer knocking down the trees along the centerline. Flanking the lead machine were two or more bulldozers that mopped out the full width of clearing. Behind these were a couple more bulldozers that cleaned up the brush and fallen trees, pushing them off to the side. The trees, even the largest, were easily knocked over, for in the Northland the trees have no deep tap roots into the frozen subsoil. The roots broom out in shallow fans, which popped out when the big bulldozers crashed against the trunks.

The head crews made no attempt to build a road, even a rough trail, but merely swamped out a right-of-way. Occasionally they had to stop to build a small bridge or culvert to get the bulldozers across a soft spot, but usually they just kept plugging ahead. One company of soldiers ordinarily formed a head outfit.

Then strung out maybe as much as

30 to 50 miles behind the lead crews were various soldier units who graded up the rough trail road, built culverts and small bridges, widened the clearing where necessary, hauled in gravel for the worst soft spots and improved or rather built a trail road. The road was shaped up and the necessary grading done with the big scrapers and graders. All operations continued day and night, seven days a week.

Equipment operators had to be developed and trained on the spot. The boys had been trained in some instances on gas tractors in camps in the United States, but many of them had only a few minutes instruction on diesel equipment before going north. Yet some of the best operators, both colored and white, were boys that had never been on construction equipment until they arrived on the project. Of course the equipment suffered considerably at first from lack of experienced operators, an unfortunate condition in view of the difficulty in getting repair parts.

Different method of attack

Each commanding officer varied the procedure somewhat. One such variation was to keep at least one battalion way back building a fairly substantial road, for manpower in the army units was plentiful and this commander figured at least part of his men might as well be building a decent trail instead of merely a rough one. Another commander flew small patrols ahead, equipped with hand saws and axes, for building bridges so that streams could be crossed when the bulldozer crew arrived. Some regiments kept pretty good records of their accomplishment, others were intent on getting through. One unit ran surveys of its own trail route, tying the exact line in with traverse points, while other survey crews plotted an accurate profile. One regiment also set up field engineering offices where all bridges and camp buildings were designed in advance. Incidentally, they turned out such a fine job or a field bakery that headquarters made it standard for the entire project.

By the time the later regiments had been organized for the project it was not possible to obtain all new supplemental equipment for them. One interesting case concerns a fleet of second-hand trucks assigned to one regiment. When this regiment left Seattle it abandoned 26 trucks on the wharf as useless, and immediately requisitioned 26 more. Two months later the requisition was filled—with the same 26 trucks that had been left behind, still in the same worn-out condition.

Except for conditions incidental to the terrain, such as going through the mountains, swamps and heavy timber, the actual building of the road was routine operation. Very little of the route was easy-going, however, and whoever named this the "Prairie Route" never saw the country. Heartbreaking and back-breaking incidents could be recited by the score, but an example or two will suffice. In crossing the Nutzotin Mountains much of the line lies high on the hillside. Sometimes a tractor or grader would go off the narrow bench and the only way to get it back would be to build a trail from wherever it landed back up the mountain to the road.

To jump a crew ahead in coming down the Tok valley, pontoons of supplies and rations, half filled for light draft, and half-filled barrels of gas and diesel fuel were thrown into the Little Tok, a surprisingly small stream for the purpose, and caught in a log boom 15 miles below. Meanwhile a fleet of bulldozers took off through the swamp and woods to the rendezvous below.

The most notable exception to normal road building was through the perpetually frozen section of the Yukon west of Whitehorse. Here permanent frost lies only a foot or so below the surface, yet this land supports heavy spruce forests. At first the topsoil was stripped and attempts were made to grade the road. As fast as the insulating cover was removed, the ground thawed, creating a morass that grew worse the longer it was worked.

Finally the scheme was adopted of leaving the original humus blanket in place, and adding to its insulating value by spreading the brush and timber cut from the right-of-way over the road area. Sometimes this mat of trees and brush would be 4 or 5 ft. thick. Then the highway fill was placed on top of the mat by end dumping. The biggest difficulty here was to find enough unfrozen material.

Gravel for the most part is plentiful. The longest distance between gravel sources is about 35 miles, requiring a maximum haul of 18 miles. The average haul, however, is less than 3 miles. For mile upon mile in some sections, roadside pits and even the grade itself supply the surfacing material. Nowhere on the original army road was the gravel crushed or screened. In fact, as yet there is but little equipment for such purposes available on the entire job.

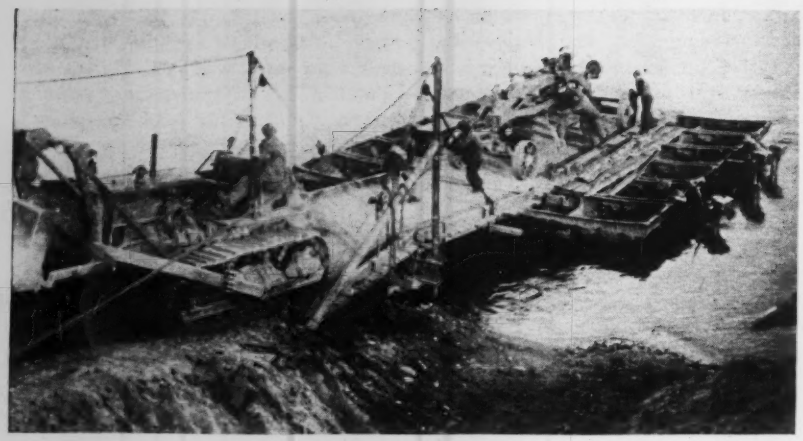
Contractors at work

The four groups of managing contractors and their associated firms were distributed as follows: R. Melville Smith Co., Ltd., of Toronto, the relocation and reconstruction of the provincial road between Dawson Creek and Ft. St. John, and also the new road west of Ft. Nelson to Watson Lake. Okes Construction Co., St. Paul, the standard road between Ft. St. John and Ft. Nelson. Dowell Construction Co., Seattle, all contract work in the Yukon, from Watson Lake to the Alaska border. For all Alaska sections the contract was held by a combination of C. F. Lytle Co., Sioux City, Iowa, and Green Construction Co., Des Moines, Iowa.

A fifth contracting firm, E. W. Elliott of Seattle, Wash., held the contract for transportation of all men, supplies and equipment from the States to the project for all the other American contractors. Later this firm also did some work on the Yukon section of the road. At first the Army took care of its own transportation, but subsequently Elliott also transported some army supplies.

On the relocation and improvement of the Dawson Creek-Ft. St. John road, the Canadian contractors under

Army bridgebuilders often used timber cribs instead of piling or framed bents. Cribs, when rock filled, will probably stand up better than framed bents in spring floods.



Army ponton detachment crosses a larger stream in advance of bridgebuilding operations. Here, six pontons are powered by outboard motors.

R. Melville Smith Co. followed the old road part of the way, but some of the route is now on new alignment. In both cases construction on this 52 mile stretch was according to PRA specifications for the final-type road. One 3-mile tangent section on new alignment across muskeg caused considerable trouble. It was necessary to remove the swampy material, 3 to 4 ft. thick, by dragline, and backfill with dry clay hauled from some distance away. The Canadians were equipped with enough portable crushing and screening plants to provide graded gravel for surfacing most of the road into Ft. St. John. When the Smith group of contractors finished the section south of Ft. St. John they were jumped to various stretches west of Ft. Nelson to improve the army pioneer road.

Okes Construction Co. made its headquarters at Ft. St. John, and its associate firms started off to build the PRA final road north of this point. Specifications called for clearing 100 ft. wide and grading 60 ft. wide. On top of the subgrade was placed 12 in. of select material (sand or any material other than muck). Next were two courses of gravel, first 8 in. of crushed material (2 in. maximum size, when available) and a 4-in. layer of 1-in. crushed gravel. No plans are made for surfacing other than with gravel, but perhaps a bituminous top may be placed on certain sections this coming summer to cut down maintenance. Actually the gravel used is largely pit run, as screening and crushing facilities are limited to one installation at the Peace River. Creosoted wood-stave culverts are called for on the PRA standard section.

On the PRA route the alignment was mostly tangent, crossing muskeg and soft ground as encountered on corduroy or by blading out the soft stuff. Side ditches and back slopes were carefully cut and trimmed. Grades were low and uniform, necessitating heavy excavation in many spots.

In addition to the 52 miles of reconstruction between Dawson Creek and Ft. St. John, the first 26 miles of route north of the latter village were built to these standards before the order was given to abandon the high-type road construction and to shift all contractors to improving the army pioneer road. These 78 miles of good road are now part of the highway.

After leaving the PRA section, the Okes group of contractors worked through to Ft. Nelson on the army road, then jumped west to various sections between that point and Watson Lake.

In the Yukon Dowell's contractors worked at first on two sections. They built the 50-mile cutoff east from Whitehorse to Jakes Corner, connecting with the army road out of Carcross toward Teslin Lake. This section was not built to the full high standards outlined above, but is a compromise between the army improved road and the PRA specifications.

The same group of contractors also started a full PRA specification route 15 miles long on the south bank of the Takhini River west of Whitehorse, which would have cut 6 miles off the army road. When the army orders for stopping high-type road construction were issued, however, this stretch was temporarily abandoned about half complete. Then the Dowell group, accompanied by Elliott's road-building forces, were scattered over various sections of the pioneer road between Watson Lake and the Alaska border.

In Alaska, Lytle & Green's contractors started a PRA section of road north out of Gulkana along the general location of the branch of the Richardson Highway to Slana. About 5 miles were partly completed when the stop-order was issued, and about a mile of this construction, eliminating a bad stretch on the old road, is all that is now in service. Also, this group of contractors was assigned to build, without any advance army pioneer road, the stretch between Big Delta, where the Fairbanks branch of the Alcan Highway meets the Richardson Highway, eastward 108 miles to Tok Junction, where the south branch comes in from Slana. This work, started from the Big Delta end, began as a high-type road, but after 50 miles or so, the standards were relaxed in favor of speed.

Some of the Alaskan group followed the army north out of Slana, others worked down the Richardson Highway branch between Gulkana and Slana, and all pitched in on the main line from Tok Junction eastward into the Yukon, where their assignments were finished. Toward the last, in all cases, the army units and contractors were working together as one big organization bent on getting the trail road converted into a passable road at the earliest possible moment.

Contractor equipment

The PRA informed the managing contractors that the government would furnish certain construction equipment, principally trucks and tractors, from the reservoir of CCC equipment. Taking these items into consideration, the managing contractors instructed each of their associated individual firms as to what equipment units they should furnish. This plan did not work out as well as anticipated, partly because some of the CCC equipment was too old for useful service, and partly because of difficulties and delays in its transportation to the project. About 5,000 pieces of major equipment are operated by the contractors.

Handicapped as they were with old equipment in a locality far from sources of repair parts and with in-

adequate repair facilities, the contractors turned out a remarkable performance. Often it was necessary to strip one piece of equipment to keep others in service, and at all times there was a shortage of units, especially trucks.

Actual roadbuilding operations were simple. In improving the army pioneer road both contractors and army units widened the clearing, built up a low grading to provide adequate drainage. Except to reduce the grade to a maximum of 10 percent, no heavy grading was done. For the most part the improved army road follows the ground surface. Cuts and fills are scarce. Contractors and engineer troops are both on the job this winter to improve the worst stretches, maintaining the road in bitter winter weather, and keeping the route free of snow.

Snow removal won't be as difficult as might be supposed. The total winter snow fall on any part of the highway, except possibly in the mountain passes, doesn't exceed 24 in. Snow removal equipment has been spotted at the rest camps, from 45 to 90 miles apart, where the road maintenance crews have been quartered for the winter. Snow fighting equipment includes 50 big V-plows mounted on tractors and 40 rotaries, in addition to scores of truck-mounted blades. Motor patrols and bulldozers can also be used if necessary.

Bridges and drainage

The drainage of this country is interesting. East of the Rockies the drainage is through several large rivers set deep in broad valleys, all tributaries of the Mackenzie. South of Whitehorse in the Yukon basin the streams are frequently marshy, often connecting up a chain of lakes. North of Whitehorse the streams change to glacier-fed rivers carrying vast amounts of glacial debris, which changes the whole character of the river valleys.

Roadbuilding, especially that on the pioneer route, was always far ahead of bridge construction. Where possible the streams were forded by equipment, even to the extent of crossing with tractors water so deep that the oil inlets had to be sealed up and only the air intake and exhaust pipes stuck out of the water. Crossing of the larger rivers at first was by ferries or ponton bridges handled by ponton companies assigned to each regiment. Usually the ferries were simply five or six pontons lashed together and decked over, powered by outboard motors.

Sometimes the army built bridges by hand tools alone, before it was possible to get sawmills and piledrivers over the road. In such cases framed bents of logs set on log mud sills carried log caps and stringers and a pole deck. Just as fast as possible sawmills were set up to produce dimension timber and planking, and piledrivers were brought in for driving the bents. Both the army and contractors worked on the bridge program. Some of the contractors had regular piledriving equipment, but often crawler cranes with swinging leads and truck cranes fitted up as skid drivers drove the piles. One regimental operations section determined the design of its trestles by building a typical span on the ground, loading it with a big tractor and measuring the deflection. From this test span the safe allowable stresses in the local timber could be determined.

Every stream along the entire route is now crossed by a pile trestle built of local timber. Such bridges or parts of them in the larger streams will undoubtedly go out with the ice next spring. It is planned to have extra piles and timber available at each important structure, along with a piledriving rig and necessary bridge hardware, for immediate replacement when a bridge or a part of a bridge does go out.

Three permanent bridges are now under construction under the direction of PRA, which has been given the responsibility for the permanent bridge program. Greatest of these is a suspension bridge across the Peace River. This is a critical crossing, and the present trestle will surely go out with the ice next April. To get work started a contract was let about Oct. 1 for two river and two shore piers spaced for a center span of 950 ft. and two side spans of 485 ft. each. The piers are being sunk through 12 to 20 ft. of water and ice and 27 ft. of gravel into hardpan. Two twisted-strand cables carried on 195-ft. steel towers and tied to concrete anchorages will support the 24-ft. roadway. The contract was let for completion April 15. Because of the speed required and difficulties in erecting steel in 50 deg. below zero weather, the towers and deck trusses may be temporarily bolted.

Two other permanent bridges are now being built across the Cut Bank River, north of Dawson Creek, and the Sikanni Chief River north of Ft. St. John. These are creosoted timber trusses, built of material shipped in from the States. For a 1,000-ft. crossing of the Muskwa, negotiations are under way to try to get some steel spans from the abandoned Southern Pacific lines in the Shasta Dam reservoir.

There are some 200 major bridges. Until some experience is gained from flood flows there is no way to determine which bridges will go out each spring or which ones will stand up under all but the most severe floods.

Such uncertainty applies to the entire drainage problem. Culverts and

Creosoted wood-stave culverts drain the finished PRA sections. These steel-bound drains are carefully placed in tamped backfill, but only in locations where the road is up to final standards.

small bridges have been installed in every location where the need seems apparent, but there will be no way to tell exactly until next spring as to just where the road should be drained. No two authorities agree as to the number of culverts that should be installed.

Bridges in the glacier country are a different problem. Here most of the streams are narrow channels meandering through wide valley floors completely covered with gravel and boulder glacial debris. Just how these small channels act in floods is not known. Perhaps they spread all over the valley, or maybe they cut new channels through the debris. The temporary bridges across these streams span the channels only. Occasionally the remainder of the valley is crossed on fill, but often on simply a low grade. It is known that these streams freeze up from the bottom, raising the water higher and higher. Old trappers report that at times the whole valley becomes a mass of ice from such action. What kind of structure would be a permanent bridge in such instances is a nice question.

Another problem is crossing glacier debris fans coming into main valleys from side streams. These deltas are usually dry, but there is evidence of heavy water flows at times. Some of these fans are wide, a half mile or so. To bridge them fully would be a big and expensive job. Consideration is being given to dredging out a definite channel, which would be bridged, with guide dikes directing the flood flows to the opening. However, at present the road usually crosses these spots on a low grade. By next summer some logical solution may be apparent from the spring runoff experience.

Still another annoying drainage problem is underground glaciers. These are numerous in the Alaskan mountain sections. A tongue of ice will be cut into in shaping up the grade. Regardless of temperature, and probably caused by pressure, these ice pockets continue to bleed a steady but small amount of water. As soon as the water reaches the road it freezes, piling up ice in layer upon layer. Culverts at such spots soon clog up with ice. The ice tongues do not have to be cut into to act up; there are plenty of cases where the glacier water oozes out of the hillside and manages to reach the road before freezing.

Communications so far depend entirely upon army signal corps radio stations. The signal corps is building a first-class telephone line the full length of the highway, but this will not be completed for some time.

BUILDING THE ALCAN HIGHWAY

The Alcan Highway is being built under the direction of the U. S. Army Corps of Engineers and the recently organized Northwest Service Command. Maj. Gen. Eugene Reybold is chief of engineers; Brig. Gen. C. L. Sturdevant is assistant chief in charge of engineer troops; Brig. Gen. James A. O'Connor, formerly in charge of the south sector is head of the Northwest Service Command. Brig. Gen. William M. Hoge was in charge of the road until June 6, and thereafter was in charge of the north sector until he was assigned to other duties. At present the direction in the field is under the following: Col. John W. Wheeler, in charge; Col. E. G. Paules, in command of the north sector; Col. R. D. Ingalls, in command of the south sector; and Col. H. L. Twichell, in command of the Dawson Creek railhead. Regimental commanders have been changed from time to time, but now include Col. A. L. Lane, Col. F. R. Lyons, Lt. Col. L. E. Robinson, Col. F. M. S. Johnson, Lt. Col. Owain J. Hughes, and Maj. J. A. McCarty.

For the Public Roads Administration, Thomas H. MacDonald is commissioner, J. S. Bright is engineer in charge of the road. Engineers in charge in the field include: Fred Capes at Ft. St. John; Frank E. Andrews and H. L. Stoddart at Whitehorse, and L. M. Huggins and C. G. Polk in the Alaska section.

CONTRACTORS ON THE PROJECT

GENERAL CONTRACTOR

E. W. Elliott Co., Seattle, Wash., R. B. Johnson, project manager

C. F. Lytle Co., Green Construction Co., Sioux City and Des Moines, Iowa, O. W. Crowley, project manager; C. C. Coykendall, field manager

Associated Firms

E. M. Dusenberg, Inc., Clear Lake, Ia.
Eblen & Eblen, Cumberalnd, Ia.
Eblen & Ekdahl, Cumberland, Ia.
Wm. Horrabin Contr. Co., Iowa City, Ia.
V. L. Lundeen, Inc., Montezuma, Ia.
Gus Ostermann, Ocheyeden, Ia.
J. W. Scothorn Construction Co., Cherokee, Ia.
Sears Construction Co., Clear Lake, Ia.
J. Leo Hoak, Des Moines, Ia.
L. Peterson, Cedar Rapids, Ia.
Welden Bros., Iowa Falls, Ia.
Western Engineering Co., Harlan, Ia.
Duvall & McKinney, Logan, Ia.
Ira VanBuskirk, Hawarden, Ia.

GENERAL CONTRACTOR

Okes Construction Co., St. Paul, Minn., Day Okes and Wm. Bates, project managers

Associated Firms

Adolphson, Huseth, Layser & Welch, Thief River Falls, Minn.
Astleford Co., Inc., Minneapolis, Minn.
Art Bolier, Minneapolis, Minn.
Brown & Leguil, Mankato and Adrian, Minn.
Coglan Construction Co., Rollo, No. Dak.
Pederson Bros., Inc., Montevideo, Minn.
Standard Salt & Cement Co., Duluth, Minn.
Thomas Bros., Foley, Minn.
Vulck Construction Co., Rice Lake, Wisc.
Sorensen & Volden, Albert Lea, Minn.
Roverud Bros., Spring Valley, Minn.
Southern Minnesota Construction Co., Caledonia, Minn.
Reese & Olson, Greenbush, Minn.

GENERAL CONTRACTOR

Dowell Construction Co., Seattle, Wash., L. J. Dowell and Ross Woodward, project managers

Associated Firms

Angeles Gravel Supply Co., Port Angeles, Wash.
L. L. and R. W. Byers, San Francisco, Cal.
J. C. Dawson Co., Seattle, Wash.
Hugh Govan and Adler Construction Co., Seattle, Wash.
Haas-Royce-Johnson, San Francisco, Cal.
Joe A. Jussel, Seattle, Wash.
C. E. O'Meal, Ellensberg, Wash.
J. S. Ramstad, Seattle, Wash.
W. C. Thompson, San Francisco, Cal.

GENERAL CONTRACTOR

R. Melville Smith Co., Ltd., Toronto, Ont., T. F. Francis, project manager

Associated Firms (All Canadian)

Emil Anderson Construction Co.
Bond Construction Company, Ltd.
Campbell Construction Company, Ltd.
Curran & Briggs, Ltd.
Don Construction, Ltd.
Dufferin Paving Company, Ltd.
W. H. Harvey & Son
A. E. Jupp Construction Company, Ltd.
Wallace A. Mackey, Ltd.
Storms Contr. Company, Ltd.
Tomlinson Construction Company
Caswell Sand & Gravel Company

Maintenance and Finance Discussed at Meetings of Highway Engineers

***Contents in Brief**—Many questions raised by the conditions under which state highway departments must operate at the present time were considered at recent meetings of the Highway Research Board and the American Association of State Highway Officials. Summaries of discussions relating to highway finance and maintenance are given in the following. Summaries of other papers and discussions will be published in a subsequent issue.*

PERTINENT COMMENT on financial conditions affecting current highway operations was given by Thomas H. MacDonald, head of the Public Roads Administration, in opening discussion of the report of the department of finance of the Highway Research Board at the 22nd annual meeting of the board held in St. Louis, Mo., Dec. 1–4, 1942.

Mr. MacDonald said that while a relatively small amount of work on the strategic highway network can be done under present restrictions on new construction, the recognition that the federal government has a greater interest in these highways than in other federal-aid work that was inherent in the recent adoption by Congress of the policy of paying 75 percent of the cost of that work may well prove very advantageous to the states in post-war operations. Also, he drew attention to the fact that the amended federal-aid act permits states to use federal funds for purchase of right-of-way. This again should facilitate an early start on post-war construction.

Decline of income

Gas-tax revenues for the nation as a whole did not decline seriously during 1942, according to Wilfred Owen of the National Resources Planning Board, who presented the report of the department of finance, but the rate of decline became much steeper during the latter part of the year. On the other hand, in some New England states, the total loss for the year will be around 50 percent. Little is known yet about the decline in registrations, but large reductions are anticipated in 1943 when licenses come up for renewal.

The finance department believes that the decline in income to the states from gas taxes and motor vehicle fees will be in part offset by the forced curtailment of new construction. In some states, however, maintenance costs will be increased due to the effect of war-generated traffic and the damage to worn out pavements that should be replaced. In attempting to analyze the effect of this decline the finance department assumed that there will be a 50 percent decline in gas-tax income in 1943, a 20 percent decline in motor-vehicle fees and no new federal aid. Applying these figures to the states, it was found that some states will end the year 1943 with surpluses while others, chiefly those with high fixed charges for bond issues, will have deficits.

Diversion to be opposed

In states that will have surpluses, those interested in highway development will need to be unusually active in opposing diversion of the surplus to other state uses. One argument they will have is the penalty carried in the federal-aid act for excessive diversions.

The finance department recommends the following uses for such funds: (1) Use of the funds to retire highway debt. This will serve in part to offset shortening of the life of pavements covered by the debt due to neglect during the war. (2) Purchase of government bonds for a reserve which can be used to offset the lack of new construction during the war. (3) Preparation of detailed plans for post-war construction. (4) Acquisition of right-of-way for projects covered by these designs.

In states where there will be deficits, the division recommends: (1) Revision of the expenditure program. (2) Work for revision of state laws affecting expenditure of highway funds, especially those that limit the funds spent on main roads.

Discussing this report, W. H. Root, Iowa State Highway Department, said he doubted whether it would be possible to get men or contractors to take care of current maintenance work, hence there may be a large amount of deferred maintenance to be taken care of after the war. W. W. Mack, chief engineer of the Delaware Highway Department said that a large part of his system built during the early twenties now is subjected to loads much heavier than those for which it was designed, hence their problem rapidly is becoming not one of repair but of reconstruction.

Large fixed charges

Mr. MacDonald stated that about 30 percent of the present state highway income goes to amortization and as this is a fixed charge, the percentage may be expected to rise sharply as income declines. Another 15 percent is diverted. On diversion, he urged the Highway Research Board and the American Association of State Highway Officials to make a strong drive to get diversion cut. He also urged highway interests to work for an upward readjustment of the amount of state road money that is made available to the highway departments. Such money is more efficiently spent and the greater concentration of work in highway department hands makes possible the drafting of a state-wide program of highway development.

Roy W. Crum, director of the Highway Research Board, urged that part of the available funds be used in continuation of the planning surveys and for research.

Opportunities for removing roadside obstructions at small cost presented by the closing of many roadside stands as a result of curtailed

automobile traffic were cited by H. S. Neale, chairman of the roadside development committee, as something not to be overlooked by state highway departments. He also urged that the present time be used for seeking improvement in the land-acquisition policies of the states. Most of such policies now handicap attempts to get the amount of right-of-way that is essential to modern streamlined highway design.

The cost of roughness

Progress on a study of road roughness that has been underway for some years was reported by R. A. Moyer, professor of highway engineering at Iowa State College. Previous reports related to the amount of motor vehicle operating costs that could be charged to roughness of gravel roads. This report related to portland-cement concrete pavements and to bituminous pavements. Its significance in current attempts to save rubber was emphasized by Professor Moyer. He also noted that their studies gave clear support to the need for reducing speeds to reduce tire wear. The rate of wear rises sharply as speeds rise above 40 mph.

Greatest tire wear occurs on bituminous pavements surfaced with chat rock chips and on broomed concrete. Lowest tire wear was found on limestone-chip bituminous pavements. As an *emergency measure*, Professor Moyer recommended the use of a seal coat on bituminous pavements that have abrasive surfaces, keeping the amount below that which will produce a slippery surface. By this means the tire wear can be cut as much as one fifth for the most abrasive type surfacing. Wear on gravel surfaces is about twice that on a normal concrete pavement.

Tire wear

Further information on tire wear was given by R. D. Evans of the Goodyear Tire & Rubber Co. who reinforced Professor Moyer's views as to the favorable effect of pavement smoothness on wear. Restrictions on high speeds during the war period have reduced the need for non-skid surfaces. On the other hand, Mr. Evans raised question as to whether the current speed limit of 35 mph. is not too low. Graphic studies of all factors affecting tire wear show that when speed is plotted against percent of normal wear, the wear curve crosses 100 percent at 35 mph., the speed limit set by federal authorities; but Mr. Evans believes that this slow speed frequently is a cause of traffic congestion that more than offsets the small saving in tire wear that is made by a reduction below Prof. Moyer's figure of 40 mph.

Highway costs and accounts

A discussion of what is meant by "highway costs," including the controversial matter of application of the public-utility theory of cost accounting to the computation of highway costs, which had been prepared by the committee on highway costs of the department of highway transportation economics, was presented in summary form by Director Crum. As in the case of the other papers presented at the meeting, this one will appear in full in the 1942 *Proceedings* of the Highway Research Board.

The impact of war has been serious on progress toward attainment of the objectives outlined last year by the committee on uniform accounting practices, said Anston Marston, chairman of the committee. Nevertheless, Dean Marston said, conditions growing out of the war, such as the loss of investment in roads that are destroyed or seriously damaged by war traffic or by enforced neglect, only serve to emphasize the need for uniformity in highway accounting. Claims for such losses can best be made under a recognized system of sound cost accounting.

Maintenance equipment

A condensation of an extensive report on standardization of maintenance equipment, prepared by a subcommittee set up to survey the extent to which such equipment has been standardized and to make recommendations as to the best types of equipment for various classes of maintenance work, was presented by Rex M. Whitton, maintenance engineer of the Missouri highway department. Included in the report are such matters as rental and depreciation practices.

The committee recommends that state highway departments should own all equipment that is extensively used and all special equipment designed for highway maintenance. Non-special seasonal equipment should be rented as required. This reduces the capital invested in idle equipment and provides work for privately-owned construction equipment that might otherwise be idle.

Administration of state-owned equipment should be by a separate department headed by an equipment engineer who is directly subordinate to the chief engineer or to the highway commissioner. The committee was far from unanimous on this latter recommendation, some favoring administration by the maintenance engineer and others the assignment of equipment to each district. Use of all state-owned equipment on a rental basis was favored, chiefly because it permits distribution of the cost of equipment against work on an equitable and reasonably accurate basis. Also, this method permits creation of a reserve fund from which to finance repair and replacement of maintenance equipment. Rental should be sufficient to cover all costs except the operator. Assessment on an hourly basis was favored, generally.

Depreciation by the straight-line method based on the trade-in value of the equipment and applied throughout the entire service life of the unit was recommended by the committee.

Commenting on the committee report, W. H. Root, maintenance engineer of Iowa, said that depreciation really is a revenue matter, a method for making provision for purchase of new equipment. If a higher type than the equipment now in service is needed, depreciation charges should be computed with such an object in view.

Patching pavements

Recommendations of the committee on salvaging old pavements as they relate to rigid pavements were summarized by A. A. Anderson of the Portland Cement Association. Methods for patching each type of break in concrete pavements are covered, including methods for handling traffic on roads that are not closed for repair work. Also included are such matters as selection of material, mixing, and use of high-early-strength concrete, the information being given in such form that each state can prepare its own manual to fit its standard specifications.

Methods for salvaging high-type flexible pavements were outlined by A. H. Hinckle of the Asphalt Institute. Departing from the committee's prepared statement, Mr. Hinckle called attention to the findings of

Professor Moyer's study with respect to pavement roughness, suggesting that during the war period highway departments should give consideration to the need for reducing the abrasive character of surfaces when undertaking "skin patching" or substantial resurfacing.

Maintenance costs

The average annual cost of highway maintenance was set at $471.32 by a sub-committee of the maintenance department headed by H. K. Bishop, chief of the division of construction of the PRA. This figure was based on a study of cost data from 18,154 miles of road, cost figures for years 1935–40 being converted to a 1925–29 price index base. The breakdown on a national basis is given below; a regional breakdown is given in the accompanying table.

Maintenance item	Annual cost per mile
Surface, routine and periodic	$194.48
Shoulders and approaches	66.67
Roadside drainage and structures	107.13
Traffic services, including snow removal, ice treatment and guard rails	103.04
	$471.32
	Percent
Labor	45
Materials	21
Equipment	25
Overhead	9

The committee states where construction betterments were performed by maintenance forces, with maintenance equipment using maintenance funds, those costs were eliminated from the computations as they were considered to be capital rather than maintenance costs. The conversion to a 1925–1929 cost base was made to neutralize the wide fluctuations that were found in prices influencing maintenance costs in the years under study, the variations amounting to as much as 40 percent from the low point.

Average surface widths for the roads summarized in the table ranged from 18.6 to 21.9; traffic per 24 hours from 689 to 3,945 vehicles; and the maintenance rating from 85 to 94. The average width was 19.8 ft., average age 6.8 yr., and the average maintenance condition 89.

A. A. S. H. O. Groups Discuss Problems

FOLLOWING the general sessions at the annual meeting of the American Association of State Highway Officials held in St. Louis Dec. 7-8 (*ENR*, Dec. 17, p. 830), group meetings were held under the auspices of several of the standing committees of the association. As discussion in meetings of the road design committee and the maintenance committee supplements discussions in sessions of the Highway Research Board, the following notes on those meetings are given.

Pavement designs modified

The importance of the part played by the subgrades in assuring the permanence of rigid pavement was emphasized by W. M. Rees of the Tennessee Highway Department in a discussion of rigid pavement in the meeting of the road design committee. He cited proper compaction as a major essential with proper drainage holding second place. Mr. Rees recommended to his readers a study of "War Time Road Problem No. 3, Design of Concrete Pavement Requiring a Minimum of Steel" recently issued by the Highway Research Board.

As to the spacing of contraction joints and expansion joints called for in the pamphlet, Mr. Rees said that the proper spacing for contraction joints is put at 15 to 20 ft. No definite recommendations for expansion-joint spacing is made, but the report states that spacings of 120 ft. are extensively used and that spacings of 400 and 600 ft. have proved satisfactory. H. C. Coons of the Michigan Highway Department stated that they had proposed spacing expansion joints at long intervals but have found the Public Roads Administration opposed to that practice. Michigan has used such long spacings in the test road it built recently.

A. T. Bleck, Wisconsin Highway Department, stated that close spacings of expansion joints dissipate the

SUMMARY OF ANNUAL HIGHWAY MAINTENANCE COSTS PER MILE AND PREVAILING FACTORS AFFECTING MAINTENANCE COSTS

Average Based on 4 to 6-year Period—57 Surface Types Included
(Costs shown are on 1925–1929 price index base)

ITEM	Region									United States
	Pacific	Mountain	West North Central	West South Central	East North Central	East South Central	New England	Middle Atlantic	South Atlantic	
Total cost	$593	$376	$407	$346	$519	$366	$1,090	$966	$374	$471
Surface	$213	$170	$216	$153	$152	$220	$245	$236	$195	$194
Shoulders and approaches	$75	$59	$28	$73	$89	$54	$136	$169	$67	$67
Roadside, drainage and structures	$189	$78	$68	$87	$128	$78	$265	$244	$81	$107
Traffic service, including snow, ice and guardrail	$116	$69	$895	$33	$150	$14	$444	$317	$31	$103
Labor	46%	45%	42%	48%	45%	42%	46%	51%	42%	45%
Materials	19%	17%	21%	21%	17%	23%	21%	22%	29%	21%
Equipment	25%	31%	29%	19%	26%	24%	28%	20%	21%	25%
Overhead	10%	8%	8%	12%	12%	11%	5%	7%	8%	9%
Miles	1,285	2,678	4,055	2,152	2,008	1,841	1,042	666	2,416	18,143
Surface width, feet	19.6	19.3	21.0	18.6	20.1	18.7	21.9	20.9	18.7	19.8
Traffic, 24-hour	1,456	689	861	1,013	1,728	765	2,364	3,945	1,104	1,203
Total maintenance rating	94	91	87	88	89	85	94	94	91	89

Note: 38 states reporting 6 years; 7 states reporting 5 years; 2 states reporting 4 years; 1 state not reporting.
Prepared by the Maintenance Section, Public Roads Administration.

effect of the interlock of aggregate in the traction joints. He believes that the expansion joint spacings should be as much as 1,200 ft. O. L. Kipp, Minnesota Highway Department, said that when his department checked with the PRA as to joint spacings, the PRA was opposed to spacings in excess of 120 ft., but did approve of joint spacings ranging from 400 to 600 ft. as an emergency measure.

H. E. Surman reported that Illinois has built 7,000 miles of highway without expansion joints and has had no trouble with blow-ups. That state is now building a 10-in. pavement to absorb the compressive stresses developed by the lack of expansion joints. Expansion joints, Mr. Surman said, cost $2,500 a mile.

Joseph Barnett, Public Roads Administration, said that with the better concrete now being used, pavement should be able to take up the stress developed by expansive forces without distress. He noted the experience of the railroad in the use of long stretches of welded rail, observing that the experience in highway work, where no abnormal movements are found at the end of long pavements without expansion joints, checks with the experience of the railroad.

Load-transfers devices

In the matter of substitutes for load-transfer devices, H. W. Griffen, New Jersey State Highway Department, said that in the studies conducted by New Jersey, both sills and a ledge joint were used. The ledge joint failed under severe test. Those with sills did not fail but in some cases cracks developed beyond the joints. Infiltration of incompressible material between the paving slab and the sill often results in a step-off at the joint. Also, if the infiltration of material into the joint is eccentric, it may result in blow-ups or spalling.

New Jersey is now using sills on an access road job. On another job it is using a sill raised up into the pavement to check the infiltration of incompressible material from the subgrade. Other joints in this pavement have flush sills and a few have ordinary load-transfer devices. These are to be studied carefully.

P. M. Tebbs, Pennsylvania Highway Department, in asking for experience in other states with redwood or cypress fillers for expansion joints, stated that such fillers were used on the Pennsylvania Turnpike and that they have become loose and rattle. It is not possible to maintain a bituminous filler in place on top of them. Answering the question, F. C. Grumm, California, said that such fillers have been used extensively in California. California designs call for a 2-in. deep groove above the filler into which bituminous material is poured.

Non-rigid pavements

G. R. Logue, chief engineer, Ohio Department of Highways, in a discussion of non-rigid pavement under war conditions, said that his state has many hundreds of miles of such pavement that now are overloaded. The state has neither the time nor the funds to take care of all the roads that should be strengthened. Hence, the highway department maintains a careful and continuous inspection in order to start resurfacing before destruction begins. In many locations it has been found that a rather thin drag treatment has kept out the water and saved a road that otherwise would have gone to pieces. Where satisfactory repairs can only be made by the addition of new material, a first course is added, just enough to fill the low spots and holes, then a second course, and finally a wearing surface. Old patches are not removed unless they are "fat". This method has been found more satisfactory than to put on the resurfacing layer in one operation.

Where old brick or concrete pavements are going to pieces, they have been reclaimed by adding $2\frac{1}{2}$ or 3 in. of bituminous material. This treatment greatly improved the smoothness of the highway.

A large amount of old 16-ft. pavement has been resurfaced without widening in order to increase the mileage that can be resurfaced. The lower speeds that now are mandatory have made this plan reasonably satisfactory from an operating viewpoint.

For some of its road work, Ohio has gone back to the use of water-bound macadam to save on bituminous oils.

Michigan plans to concentrate on resurfacing next year in order to conserve its roads, according to Harry Coons, chief engineer. The Public Roads Administration has let them use federal-aid money for this work where the roads are on the strategic networks. Mr. Coons pointed to the desirability of digging out expansion joints in this resurfacing work. If left in place, they work up and destroy the new surface. The subgrade is not disturbed except where it obviously is bad, in which case bad material is dug out and replaced with well compacted new material.

Road Maintenance

A variety of matters were discussed in meetings of the maintenance committee. Due to the scarcity of equipment, B. W. Davis said that North Carolina had gone back to the use of wood drags to reduce the use of blade graders. Blading that used to be done simply to improve the surface has been eliminated. Traffic-lane marking has been curtailed and wooden signs are being used for all new road markings. Maintenance on these signs is higher than on metal signs.

In North Carolina the shortage of repair parts for the highway equipment is more critical than the equipment situation itself. Scarcity of bituminous materials makes it necessary to go back to some lower type of surfacing. The highway department anticipates that many roads will have to be reclassified so that available materials and equipment can be concentrated on the more important roads.

Prison labor on roads

A question as to the extent prison labor is being used for highway construction brought responses from most of the states of the southeast that prison labor has been used for some classes of road work for many years. Generally, due to the growing scarcity of labor, the use of this type of labor is expected to be more extensive. Virginia, for example, has used prison labor for many years on primary roads and now is using it on secondary roads. West Virginia has used prisoners on construction work and now is considering using them for maintenance work where labor is getting scarce. Alabama has used convicts on both maintenance and construction for several years, permitting convicts to operate mowers, trucks and graders. This practice of permitting convicts to operate equipment is not common in other states. Use of convict labor on federal-aid projects is opposed by the PRA.

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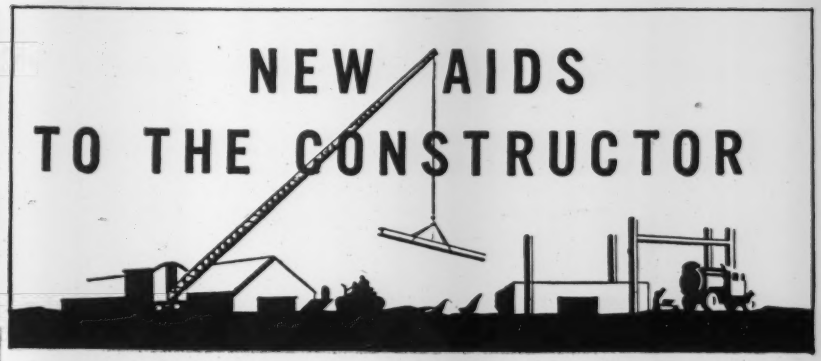


Photoelectric Controls

To meet today's need for dependable automatic control of varied industrial operations, an improved series of photoelectric controls, specified as type A-15, has been announced by Photoswitch Incorporated. Latest engineering developments embodied in these controls include relay contacts designed to handle heavier loads directly, and conservatively rated at 10 amp. a-c at 115 volts. The output terminals are those of a single-pole double-throw switch, for either normally closed or normally open operation. This provides for action either when the light beam is broken or when it is made. The operating range of Type A15 is 20 ft. with light source L30, and 40 ft. with light source L60. Also available is Type A25, which is supplied with light source L30 for 50 ft. operation, and with light source L60 for 100 ft. operation.—*Photoswitch Incorporated, 19 Chestnut St., Cambridge, Mass.*

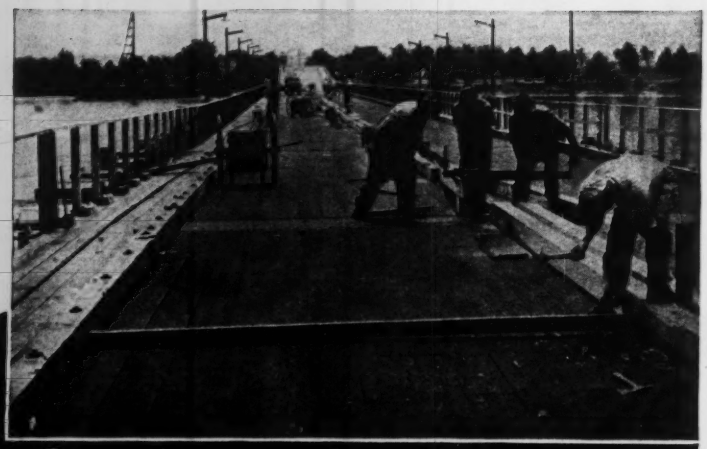
Asphalt Flooring over Wood Base

With the shortage of structural steel, the problem of findings satisfactory alternates presents a difficult problem. However, a new product known as Elastite Industrial Flooring, which is an asphaltic product can be used over a solid wood base with definite advantages. Advantages claimed by the manufacturers for the product are: hardness, toughness and density resulting in remarkable resistance to wear and abuse; ability to withstand moving loads of great intensity;

Field Lubrication Unit

As an aid to contractors who must keep irreplaceable construction machinery operating at peak efficiency, the Gray Co., Inc., have announced the addition of a new Graco convoy luber to their line of portable lubrication units.

The model LU-150 Graco convoy luber was designed primarily for the smaller contractor, who may not need a large portable field lubrication unit, but who feels the need of some sort of power lubrication for his equipment. The new luber dispenses lubricant directly from original 100-lb. drums; is powered with a 4½ hp. air-cooled gas engine, running a 12 cu.ft. air compressor with working pressure of 175 lb. air pressure. Three lubricant pumps dispense gear lube, track or hypoid lube and chassis lube. Four large hose reels with locking brakes provide three 30-ft. high pressure lubricant hoses which make the largest of equipment accessible to the convoy luber. A 50-ft. air line on the fourth reel services large pneumatic tires.—*The Gray Co., Inc., Minneapolis, Minn.*



Pontoon Bridges at
NATION'S CAPITAL paved
WITH Carey Elastite
ASPHALT PLANKING

Yes, a pontoon bridge—but not exactly the kind that our fighting boys throw across a river to get to the enemy. The photograph shows one of the pontoon bridges that Uncle Sam has built across the Potomac at Washington, D. C.

Paved with Carey Elastite Asphalt Planking—a non-critical material—these bridges have a wearing surface that is extremely durable under heavy traffic and provides waterproof protection to the wood base. Light weight, combined with strength, are additional important advantages, permitting use of this product where heavier materials would be impractical. Approximately 25 carloads—64,000 sq. ft.—were used on the bridges.

Carey Elastite Asphalt Plank is a composition of asphalt, asbestos fibre and mineral filler, formed under heat and tremendous pressure into units of convenient size for easy and rapid application. Recommended for flooring bridges, railroad crossings and for some highway and industrial uses. May be laid over any type of base that furnishes the necessary firm, smooth and continuous support.

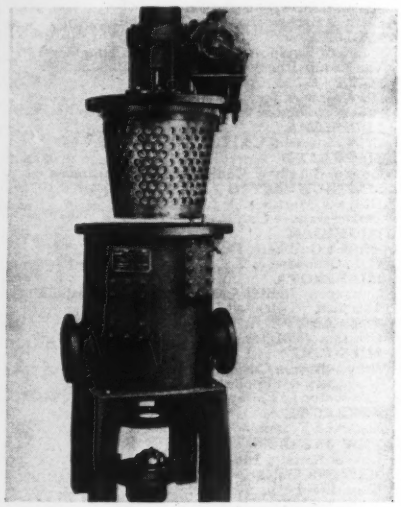
If you have a special problem in paving or surfacing in which extreme wear-resistance and water-proofing are important, investigate the advantages of CAREY Elastite Asphalt Plank. A nationwide organization is at your service. For details, address Dept. 30.

THE PHILIP CAREY MANUFACTURING COMPANY
Dependable Products since 1873
Lockland, Cincinnati, Ohio
In Canada: The Philip Carey Company, Ltd., Office and Factory, Lennoxville, P. Q.

resiliency that makes it comfortable underfoot, less tiring to workers; non-skid surface that lessens accidents; resistance to fire and moisture; dustless surface which is necessary in so many industries; reasonable cost; and low maintenance. —*The Philip Carey Mfg. Co., Lockland, Cincinnati, Ohio.*

New Strainer

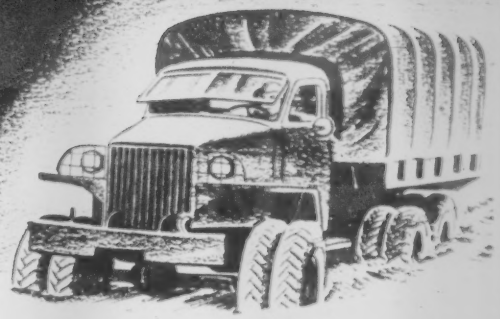
The scope of the use of the Brassert self-cleaning water strainer has been greatly enlarged, according to the manufacturer, since the strainer is now built of special materials for use in straining sea water, and also for service at coke and similar plants for straining ammoniacal liquor. The strainer removes fine suspended particles from raw or process water, and disposes of these particles in a continuous, automatic and self-cleaning manner.



The new Brassert self-cleaning water strainers for sea water are equipped with ni-resist cones, chrome-nickel body and covers, admiralty metal ring gear and monel metal liners, stellite bushing and sleeve, stainless steel main shaft and pinion gear, and stainless steel retainer rings for stainless or porcelain straining media.

The strainer consists essentially of a slowly rotating conical drum, mounted on a vertical shaft, within a cast iron housing. The entire surface of the drum is drilled to receive the straining media which consists of porcelain discs, or flat or conical wire stainless steel screens. The raw water or other liquid enters this through an inlet at the bottom of the housing and rises around the outside of a revolving drum. Discharge of clean water is effected through an outlet at the bottom of the housing. Water entering the strainer is under pressure, and therefore passes through the straining elements in the drum, depositing foreign matter on the surface of the perforated

POWER *and Traction*



TO KEEP YOUR GRADERS ROLLING FOR VICTORY...

- ✓ Check condition of engine regularly.
- ✓ Change lubricating oil and renew filter elements every 100 hours of use.
- ✓ Lubricate all parts of grader regularly.
- ✓ Service air cleaner every 10 hours of use.
- ✓ Clean fuel oil filters at least every 60 hours.
- ✓ Don't ride clutch. Adjust clutch pedal when and as needed.
- ✓ Keep electrical system in good condition —check battery regularly.
- ✓ Keep lost motion out of grader—use adjustments for wear and replace parts worn out.
- ✓ Keep tires inflated to recommended pressure.

If you need help or advice on any of the above, see your local Adams distributor.

★★★ POWER and TRACTION are what it takes to get mammoth army trucks over rough roads in all kinds of weather to bring vital supplies to the fighting fronts . . . POWER and TRACTION are enabling Adams Motor Graders also to work in soil conditions ranging from sticky mud to loose sand to complete wartime grading and ground leveling jobs quickly and economically . . . POWER and TRACTION are but two of the many features you'll like in Adams Motor Graders when once again you are permitted to buy equipment for use on peace-time projects!

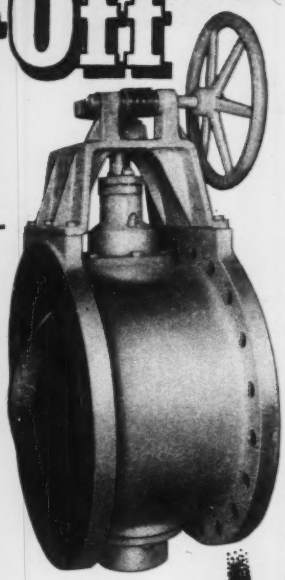
J. D. ADAMS COMPANY • INDIANAPOLIS, INDIANA

Adams motor graders, leaning wheel graders, elevating graders, hauling scrapers, tamping rollers, bulldozers and road maintainers are used by allied forces throughout the world.

Adams

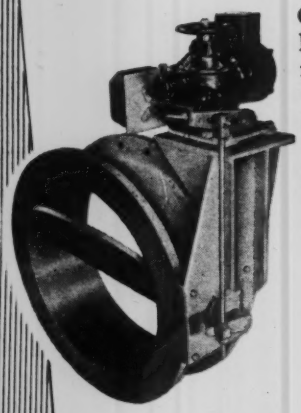
ROAD-BUILDING AND EARTH-MOVING EQUIPMENT

Simplify Shut-Off



Consider the advantages of R-S Butterfly Valves from the standpoint of installation, operation and maintenance.

The comparatively light weight and compact design of these valves effect a substantial saving in installation costs. Less space and supporting structure are required. A quick-action valve yet easily and smoothly operated. *Six handwheel revolutions completely open the valve or close it wedge-tight.*



Can be operated by electric motor, hydraulic cylinder or combined motor and manual control for a wide range of services. Electric motor operated valve (illustrated) has a hand wheel for manual operation in case of current failure. Available in 125 pound iron, 150 and 300 pound steel. Sizes to 84-inches and pressures to 600 pounds.

There are no right angle bends or reverse turns to collect sediment. Streamlined construction induces self-cleaning. Maintenance is no problem—constructed to last for years.

Write for Catalog No. 15-B, approximate weights and detailed dimensions.

BUTTERFLY VALVE DIVISION

R-S PRODUCTS CORPORATION

116 Berkley Street • Philadelphia, Penna.

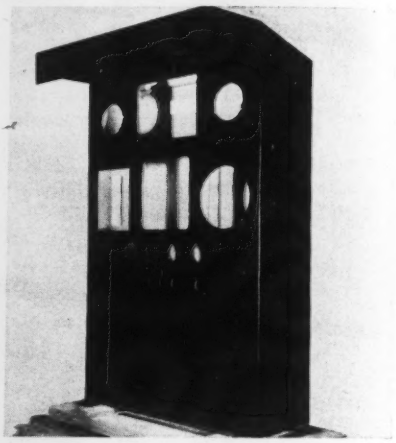
R-S Streamlined BUTTERFLY VALVES

discs or screens where it is carried to a backwash slot.—*S. P. Kinney Engineers, 233 Oliver Ave., Pittsburgh, Pa.*

Control Panels

A new panel, hailed as an innovation in its particular field, has been produced by the Hays Corp. through the use of Masonite, reinforced with steel angles.

The body of the panel is made of cross-grained Masonite, 5/8 in. thick, bolted to



a framework of 3x3 angle steel. Braces of 2x2 angle steel reinforce the center of the panel to insure adequate support for instruments and controllers. Masonite material is said to be extremely hard and takes a finish comparable to steel. All of the features that have made Hays steel panels outstanding have been retained in the new Masonite panels.

The manufacturer says that in preliminary tests for weights, stresses, etc., the Masonite panels have shown up very well.—*The Hays Corp., Michigan City, Ind.*

Floor Patch

The Flexrock Co. has announced a new product — Instant-Use — to make quick patches in rough floors in the midst of traffic. The patch is said to be spark-proof, resilient, and will hold tight to old concrete or other floor surfaces. Applied simply by sweeping out the hole to remove loose particles and foreign substances, primed with a primer, shoveling the new material into the hole and tamped lightly to smooth out the patch. The manufacturer claims that as soon as the patch has been smoothed down, it can be opened to any amount of factory traffic without further delay.—*Flexrock Co., 23rd and Manning Sts., Philadelphia, Pa.*

Speeding Guard Rail Erection

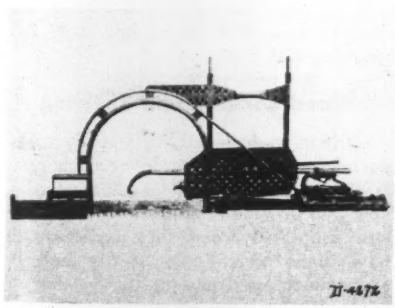
The Novo pavement and concrete breaker has a new attachment for speeding the digging of post holes for highway

guard rails. A heavily reinforced pointed cylinder punch placed on the end of the 3300 lb. hammer in place of the breaking nose has been successfully used on various types of grades where guard rail posts are to be placed. On the average, only three blows of the hammer are re-

quired to put down the post hole with this punch, saving considerable time and labor on the operation. This accessory can be used on any of the Novo breakers in the field or furnished with a new outfit. Also furnished with a special cutting nose, it can be used for cutting trenches in the pavement without spoiling the rest of the street. A long blade can be used on the hammer for cutting frozen ground on winter digging jobs.—*Novo Engine Co., Lansing, Mich.*

Pneumatic Saw

An improved model of the Davey pneumatic saw, a 24-in. saw known as Model 2-A, is now available to the armed serv-



ices and to industries with adequate priorities. The saw is said to be able to wedge more quickly due to its narrow blade; takes a ⅛ in. cut against a ⅜ in. cut usually secured by using the standard chain saw; the blade utilizes standard saw teeth and can be sharpened in the same manner as a hand saw, and no special equipment is said to be required for

For Safer, Easier, Faster Work

Get the Right BUDA JACK for your Job!

BUDA JACKS have been proving their ability to handle the toughest lifting jobs throughout industry for 31 years — with complete ease and safety. There are more than 170 sizes and models all engineered for specific applications. Capacities range from 1 to 100 tons. Write for full information and literature on the complete line of Buda Jacks.

(LEFT): Buda Automatic Lowering All Purpose Ratchet Jacks—for loads up to 15 tons. (RIGHT): Buda Ball Bearing Journal Jacks—loads to 50 tons.

(RIGHT): Buda Hydraulic Jacks —Single and 2-speed models for loads up to 25 tons . . . THESE ARE JUST 3 OF MORE THAN 170 BUDA JACK MODELS—*WRITE FOR DETAILS.*

THE BUDA CO. HARVEY (Chicago Suburb) ILL.

EMPIRE COLD-HEADED BOLTS*

STRONGER—Close-grained metal used; grain structure intensified by bolt-making processes and heat treatment.

TOUGHER—Cold-reduction of shank toughens skin surface for threading.

CLEANER—Threads *cold-worked;* strong, accurate, clean for quick assembly.

QUICKER—Point chamfered (60°) for ease in assembly.

*Up to ⅞" x 8"; larger sizes manufactured by another method.

EMPIRE NUTS*

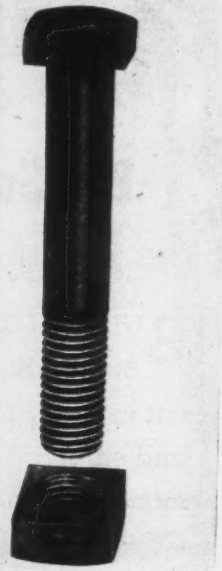
STRONGER—Hole is punched at *right angles* to grain — no splitting.

TOUGHER—Processed to guard against stripped threads.

CLEANER—Tapping is done with frequently-changed taps.

QUICKER—Accurate tapping means nuts run on fast; counter-boring of hole means quick get-away.

*Common nuts are processed cold through ⅞".



EMPIRE and allied fastening products since 1845

RB&W *Making strong the things that make America strong*

RUSSELL, BURDSALL & WARD BOLT & NUT COMPANY

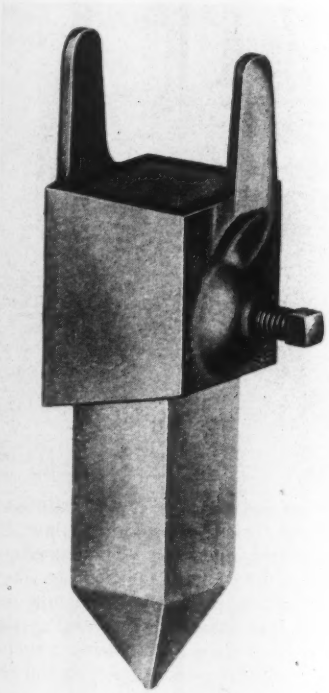
Factories at Port Chester, N. Y., Rock Falls, Ill., Coraopolis, Pa.

Sales offices at Philadelphia, Chicago, Detroit, Chattanooga, Los Angeles, Portland, Seattle

the maintenance of the saw, low price blades being utilized.—*Davey Compressor Co., Kent, Ohio.*

Adjustable Screed Cap

An adjustable screed cap that saves time and conserves critical materials according to its manufacturer is now obtainable. The cap is set on 2x2-in. wooden



stakes, which can be made by the contractor at the job to fit the conditions, thus permitting short stakes for hard ground and long ones for fills of various depths. The wooden stake is driven first and then the cast, malleable-iron cap is quickly slipped on and adjusted to the proper level. Either a wooden 2x4 or a 2½ in. pipe screed fits nicely in the screed caps.—*Whiteman Mfg. Co., Los Angeles, Cal.*

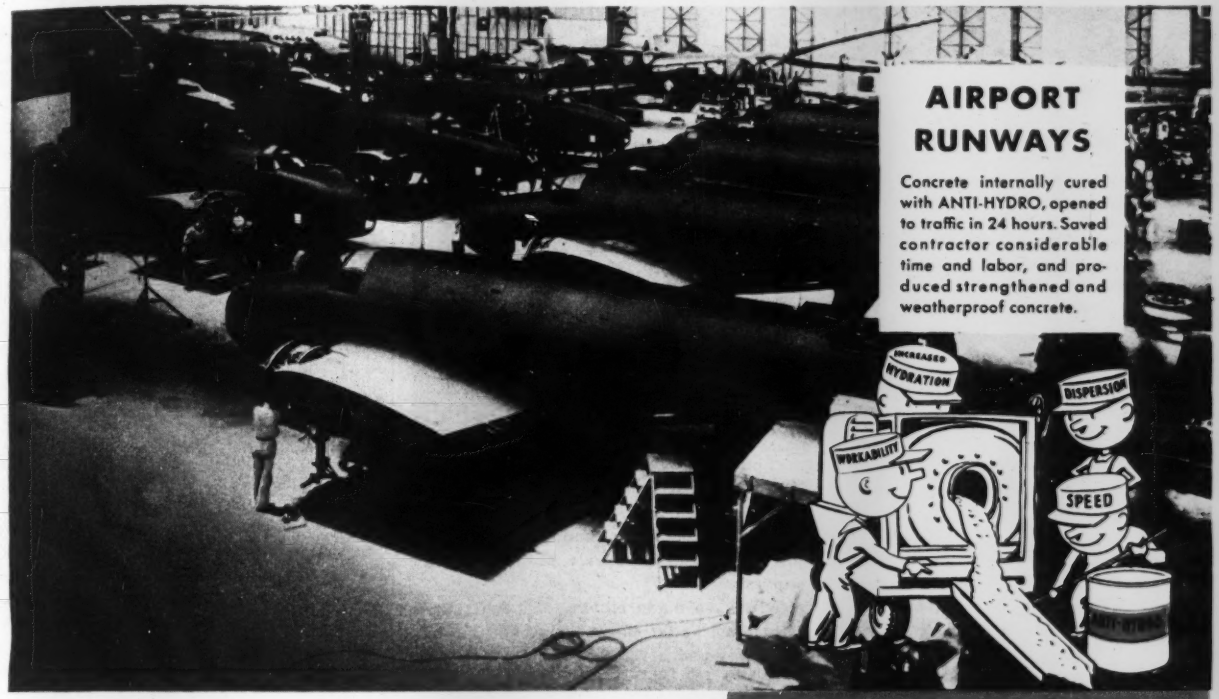
Wood Lockers and Shelving

Originally designed for the Navy Department, and adopted by it from preference, the Ivel Corp. has announced a new line of Victory wood clothes lockers and simplified wood shelving. Said to have light weight, be sturdy and of economical construction, the product is made of plywood or pressed wood, substantially framed and finished in olive green eggshell enamel. Various sizes and combinations are available.

The shelving is a new line, based upon a novel principle which permits the secure engagement of members without the use of any hardware whatever and without the employment of skilled labor. The product is exceptionally strong, will

CONCRETE EXAMPLE

of Anti-Hydro Internal Cured Floor—Poured Today . . . Used Tomorrow


AIRPORT RUNWAYS
Concrete internally cured with ANTI-HYDRO, opened to traffic in 24 hours. Saved contractor considerable time and labor, and produced strengthened and weatherproof concrete.
INCREASED HYDRATION
DISPERSION
WORKABILITY
SPEED

Floor of assembly room of an airplane plant—dust proof, wear proof—poured one day, used the next, thanks to Anti-Hydro

Anti-Hydro is to concrete, what alloy is to steel. Concrete mixed with Anti-Hydro has increased density, hardness, strength and durability, a fact proved by U. S. Government and independent laboratory tests. The time saving, labor saving, and favorable results are important reasons for specifying and using Anti-Hydro.

SPEED

Floors open to trucking in 24 hours.
Finishers troweling can start 2 to 3 hours after screeding.
Accelerates and protects concrete in freezing weather.

CURING

Integrally cures—no surface curing needed.
Lubricates mixture during handling and placing.

ECONOMY

Its use adds nothing to mixing cost.
Saves labor and overtime of cement finishing.

RESULTS

Hardens, dustproofs, waterproofs in one operation.
Saves time, labor and money.

Send This Coupon for A. I. A. Data Folder

GUARANTEED RESULTS

A 5-year maintenance guarantee, based on 38 years of successful performance, can be furnished on Anti-Hydro gauged concrete floors, installed under manufacturer's supervision.

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ANTI-HYDRO WATERPROOFING CO.

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NATIONALLY DISTRIBUTED by building supply dealers in all principal cities of the United States and Canada

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Please send me A. I. A. folder on Anti-Hydro.

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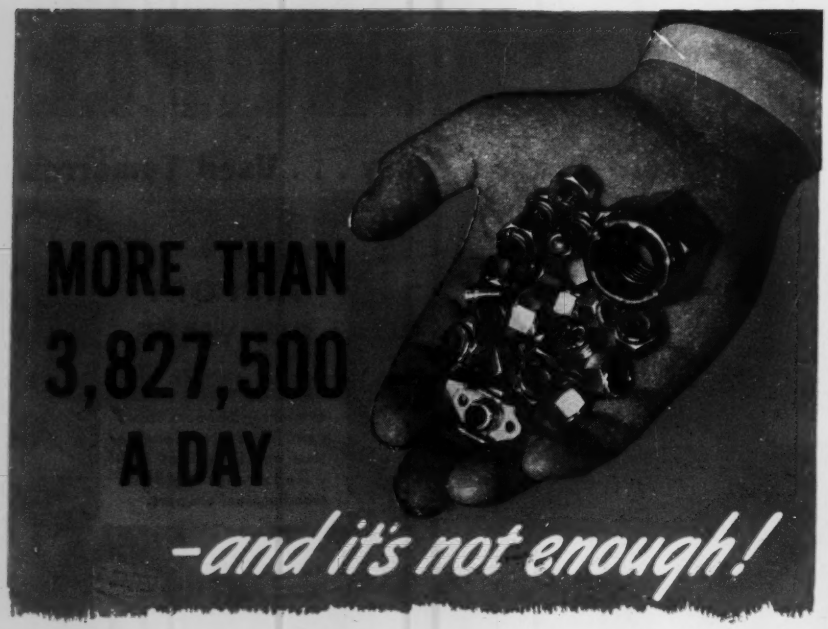


EVERY single day almost four million Elastic Stop Nuts go into war production.

Even at that, it doesn't fill the demand.

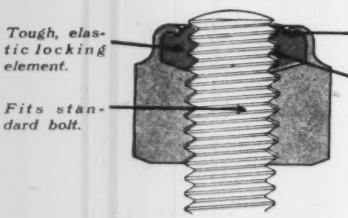
It happens that the most urgent need right now is on aircraft. Every American plane that takes the air has some important part of its structure fastened with these strong, tight-holding nuts. Some types take as many as 35,000 in a single ship.

The reason is: *these nuts stay put under the toughest circumstances.*

Once on, they stay there. But you can take them off and put them back on many times and they won't lose their locking ability.

This is why there are more Elastic Stop Nuts on America's planes than all other lock nuts combined. And why they are also used in important structural applications on guns, naval vessels and other war equipment.

We have made billions of Elastic Stop Nuts and, as far as we know, not one has ever loosened.


Tough, elastic locking element.
Fits standard bolt.
Seals threads at top — prevents corrosion of working threads.
Locking collar cannot harm the bolt threads.

• Write for folder explaining the Elastic Stop self-locking principle.

ELASTIC STOP

SELF-LOCKING NUTS AND AIRCRAFT FITTINGS

ELASTIC STOP NUT CORPORATION *2330 Vauxhall Rd., Union, N.J.*

WITH THE RED COLLAR—SYMBOL OF SECURITY

FASTER • BETTER • STRONGER

HYDRO-TITE FOR BELL & SPIGOT PIPE JOINTING

Hydro-Tite is a dependable self-caulking sulphur-base compound for jointing water mains and soil pipe—costing less than lead—requiring no skill to make tight joints. Same crew can lay more pipe per day. Stands deflection and vibration. In use 30 years without failure.

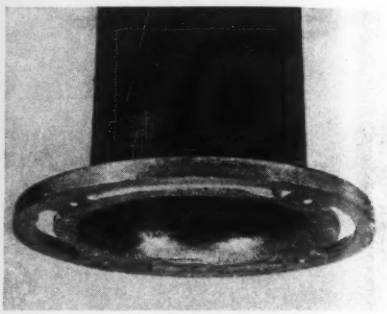
Write for Jointing Book.

HYDRAULIC DEVELOPMENT CORP.
50 CHURCH STREET — NEW YORK, N. Y.

support greater loads than any fo[r] which industrial shelving is ordinarily used, and is instantly adjustable within wide range of spacing for shelf leve[ls] and dividing partitions.—*Ivel Corp., [2]1 W. 61st St., New York, N. Y.*

Water Closet Floor Flange

To save brass and to avoid delays in installing fixtures, a new type water closet floor flange has been developed by Lead Industries Association. This flange, made of hard lead, is intended to take the place of the conventional brass



flange for the same purpose. It is of a new pattern, having four bolt slots instead of three, with reinforcing webs between slots. Greater range of adjustment of closet bolts is provided than by the conventional pattern three slot flange. This flange can be soldered directly to the closet bend without preliminary tinning. An added advantage is that it can be welded or burned to the lead bend, thus eliminating the use of solder entirely.—*Lead Industries Association, 420 Lexington Ave., New York, N. Y.*

Computer

A new device has been introduced to facilitate computations wherever gas is measured by orifice meter. This orifice computer is made in two designs and three sizes, of transparent discs on white opaque back and is said to be exceptionally useful for quick determination of rate of delivery of gas through an orifice meter; size of orifice to install in a meter; differential to maintain to deliver a desired rate and other similar uses. No coefficient for the orifice is necessary in order to use this instrument, but if the coefficient or gas characteristics are known, all corrections are provided on the utility and desk size computers to permit accurate computation.—*The Sonney Orifice Computer, Central Avenue Extension, Oil City, Penna.*

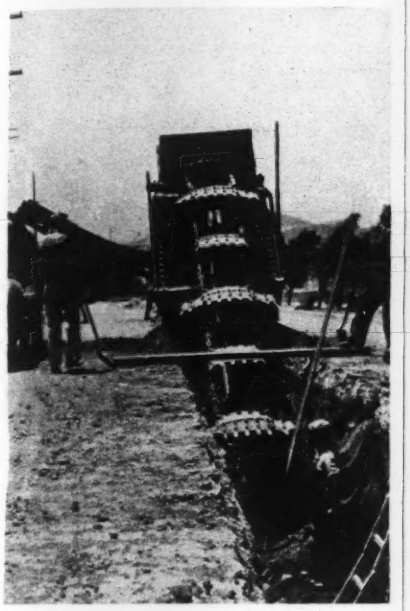
Substitute for Steel

A fireproof, rot-proof device of great strength to replace steel, wire and paper for holding home insulation in position on the unfinished sides of walls and floors has been invented by the Reardon In-

sulation Co. The Reardon device is made from gypsum and is available without priorities. Patent steps have been taken. The device, known as a Batsy, is being manufactured and sold nationally by the Insulators Supply Co.—*Insulators Supply Co., 2837 Stanton Ave., Cincinnati, Ohio.*

Trencher

By adding side cutters on every other bucket, changing the specifications of a Buckeye 120 trencher from one digging a trench 30 in. wide and 11½ in. deep to one digging trench 60 in. wide and



11½ in. deep, a San Francisco construction firm recently completed a contract for installing exceptionally large gas pipe. The digging was through San Francisco red rock formation at a depth averaging 7½ ft. and entirely satisfactory digging results have been reported.

The manufacturer cites this instance as an example of the versatility of the Buckeye trenching equipment.—*Buckeye Traction Ditcher Co., Findlay, Ohio.*

Stacking Box Carrier

This new heavy-duty carrier is designed specially to handle a column of self-nesting boxes of finished parts, scrap, castings and similar materials. The built-in wedge at bottom of lift post slides under stack, eliminating the use of a skid. After sliding the wedge under the stack, all that is necessary is to lean on the handle and stack of boxes is raised from the floor, and when the handle reaches a horizontal position it automatically locks into position. This raises the load 3 in., off the floor, thus permitting easy movement without tipping. The equipment can be operated by one man. Forward tipping

THERE'S a very good reason why Carver pumps are serving today on hundreds of tough jobs where other pumps failed . . . it's because CARVER design licks trouble *before* it starts!

Mud, sand and grit hold no terrors for a Carver pump because:

1. *Carver "streamlined" water flow through the pump is unobstructed by "gadgets" that clog up or impede the flow so that foreign matter is deposited inside the pump.*
2. *Carver impeller design limits wear to one side of the impeller only, which means longer useful life even under highly abrasive water conditions.*
3. *Carver "Lifetime" Seal of Tungsten Carbide is hard enough to cut glass; far too hard for sand or grit to abrade!*

If you want more water with less power, longer pump life with less down-time for repairs, you'll be hours and dollars ahead with a CARVER. Write or wire today for complete information on CARVER Centrifugals, available in capacities from 5,000 to 125,000 GPH, gasoline engine, electric motor or belt-driven models.

CARVER PUMP CO., Muscatine, Iowa

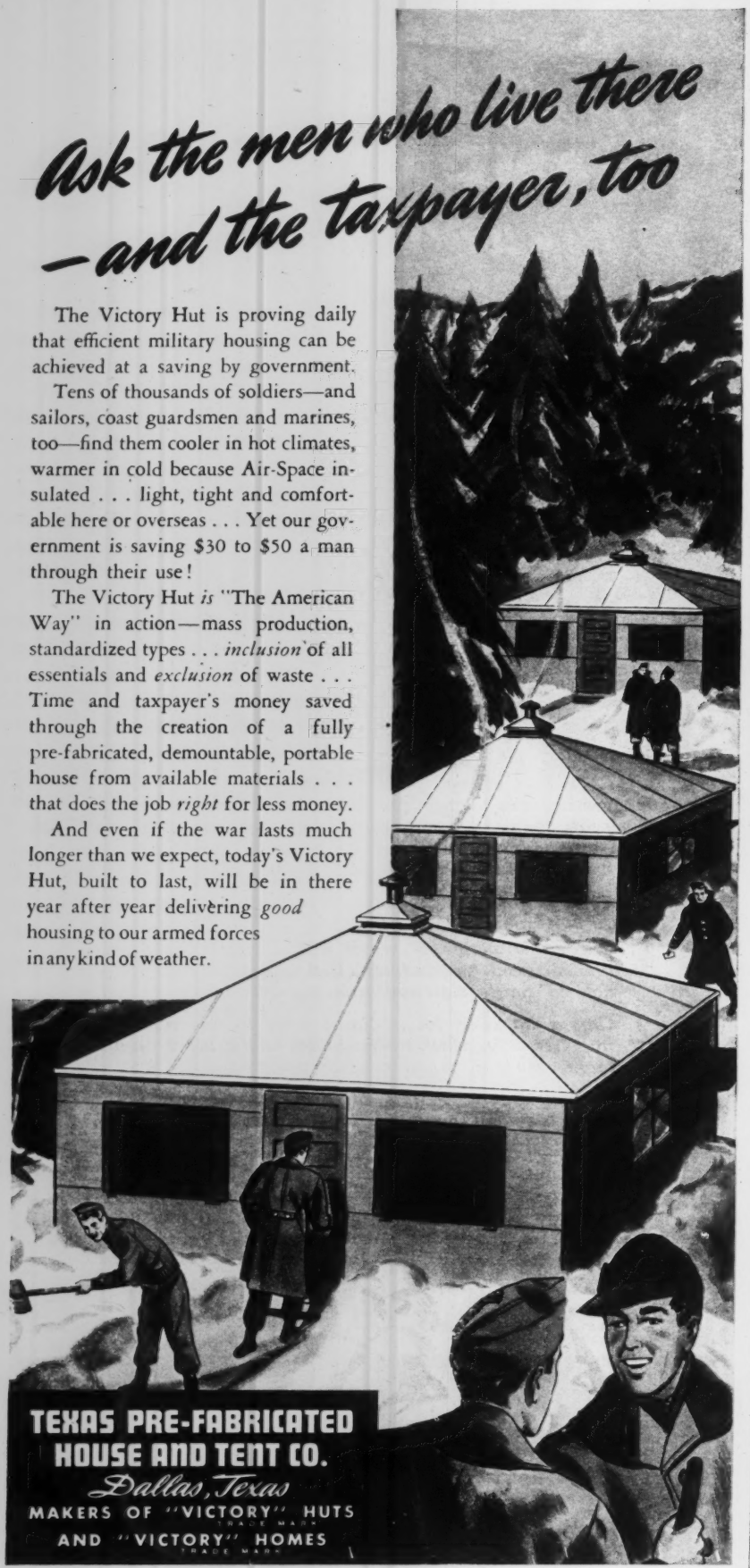
Ask the men who live there —and the taxpayer, too

The Victory Hut is proving daily that efficient military housing can be achieved at a saving by government.

Tens of thousands of soldiers—and sailors, coast guardsmen and marines, too—find them cooler in hot climates, warmer in cold because Air-Space insulated . . . light, tight and comfortable here or overseas . . . Yet our government is saving $30 to $50 a man through their use!

The Victory Hut *is* "The American Way" in action—mass production, standardized types . . . *inclusion* of all essentials and *exclusion* of waste . . . Time and taxpayer's money saved through the creation of a fully pre-fabricated, demountable, portable house from available materials . . . that does the job *right* for less money.

And even if the war lasts much longer than we expect, today's Victory Hut, built to last, will be in there year after year delivering *good* housing to our armed forces in any kind of weather.



TEXAS PRE-FABRICATED HOUSE AND TENT CO.

Dallas, Texas

MAKERS OF "VICTORY" HUTS AND "VICTORY" HOMES

or swaying is eliminated by adjustable clamp that lowers over the back edge of the top box, while side sway is eliminated by a reinforcing bar that is mounted diagonally from the top of the post to the base. This new stacking box carrier is equipped with four large diameter wheels and the square base inside measurements are 33 in. wide. Rated capacity is 1500 lb.—*Ernst Carrier Sales Co., 1456 Jefferson Ave., Buffalo, N. Y.*

Traffic Markers

Recommended for permanent marking of busy city streets and highways, Armorflex traffic markers have also been found useful for marking centerlines on airport runways, marking garages and parking lots, and even on asphalt tennis courts. Their suitability for blackout

marking of all kinds has attracted some attention. The markers, rectangular in shape, are usually used in sizes of 3 in. by 6 in. by ⅛ in. thick, and are supplied in many colors.

The markers are applied to the surface of the paving with a special hot asphalt mastic. On asphalt paving they soon become inlaid from the action of traffic, and the heat from the mastic with which they are applied causes the markers to become flexible so they conform closely to any pavement unevenness.—*Armor-Flex Co., St. Louis, Mo.*

Pump Tank Fire Extinguisher

In conformance with the emergency requirements of the U. S. government, the American-LaFrance-Foamite Corp. have designed a new pump tank with the amount of critical materials in its manufacture reduced to a minimum. This new pump tank produces a straight stream and not a spray; this is in compliance with the latest requirement of the Office of Civilian Defense for controlling magnesium type incendiaries. The new pump tank is made in 5-gal. and 2½-gal. sizes. It has an over-sized air chamber assuring minimum pulsation, a steady pressure and a more constant stream. It has a range of 30 to 40 ft., and is a self-contained unit, readily transported by ladders, over roofs and to points difficult of access. It is equipped with a standard 26 in. hose and the interior has a corro-

REQUIRES LESS CAPITAL INVESTMENT

You buy only the Wood Roadmixer. Standard crawler tractor, used for pulling and powering the Wood Roadmixer, and supply truck are usually available from existing rolling stock. This means an initial saving of thousands of dollars.

REQUIRES LESS EQUIPMENT

The Wood Roadmixer requires only two additional pieces of equipment, neither of which are permanently tied up. When the Roadmixer is not in use, the tractor and supply truck can be detached for other work, which eliminates costly idleness.

REQUIRES LESS MANPOWER

Any good scraper man can competently handle a Wood Roadmixer. On the average paving job only two men are needed —one on the tractor—one on the Roadmixer. Labor costs are held to an absolute minimum, manpower is efficiently utilized.

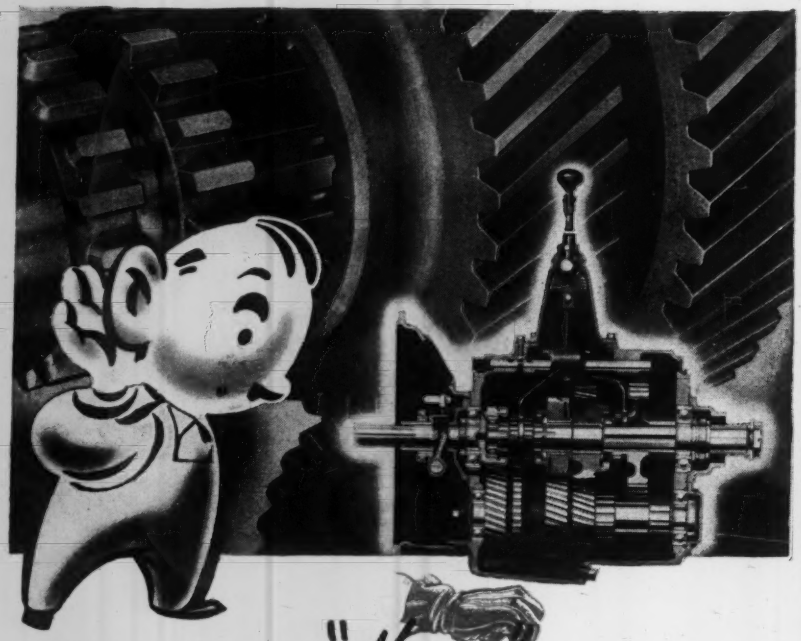
DELIVERS HIGHEST PRODUCTION

On many jobs in this country and abroad, Wood Roadmixers are delivering as much as 2,000 tons of mix per 8-hour day... These are reasons why this leading traveling plant method of pavement construction builds better paving for less money.

Write for detailed and illustrated Wood Roadmixer bulletin, "The Fastest Method of Low-Cost Paving."

WOOD ROADMIXER

Wood Manufacturing Co. • 816 West 5th St., Los Angeles, California



"Hear" CAN YOU WEAR?

You bet you can . . . every mechanic knows that noise is almost certain to mean wear—especially is this true of gears. Unless gears are "mated"—accurately matched to a perfect mesh—they fight each other and noise is a natural consequence—extra wear certain.

Fuller Transmissions are quiet. Note how smoothly you can shift from one speed to another. The driver doesn't have to "fight the gears" or learn tricky shifts. It makes his job a lot easier—reduces fatigue—and most important of all assures longer gear life.

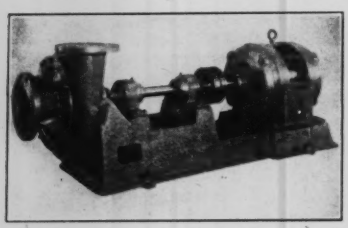
Let your truck dealer tell you why Fuller Transmissions are standard on so many nationally recognized trucks.

FULLER MANUFACTURING COMPANY . . . . . KALAMAZOO, MICHIGAN

LAWRENCE PUMPS

Where Other Pumps Clog — use Lawrence Side Suction Centrifugals

ENGINEERED TO YOUR JOB



This is the ideal pump for your unwatering cofferdams, excavations, and such jobs where water containing grit and trash has to be handled at lowest cost for upkeep and power. These Lawrence pumps are built in a wide range of sizes, for any type of drive. Horizontal and vertical types. They're simple, strong, correctly proportioned, with sealed bearings. All working parts readily renewable. If you want *lowest* cost of unwatering . . . come to Lawrence.

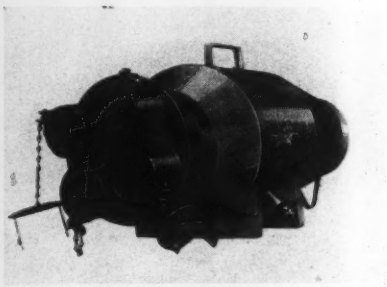
Write for Bulletin #202.

LAWRENCE MACHINE and PUMP CORP.
369 MARKET ST. LAWRENCE, MASS.

sion-resisting coating. This product is approved by Underwriters' Laboratories with a Class A-1 rating.—*American LaFrance-Foamite Corp., Elmira, N. Y.*

Portable Unit Gas Eliminator

A new small, portable unit to eliminate gases, fumes, etc., from closed-in places, such as shipholds, welding rooms, tunnels, vaults and basements, has been developed. The unit is powered by a



¾ hp. ball bearing motor, newly developed heavy steel wheels; sucks or blows 2,000 cfm., and operates in any position. The unit weighs 70 lb. Adapters for three 4-in. nozzles or four 3-in. nozzles for flexible hose are furnished with caps to close nozzles when not in use. Each 4 in. metal hose of 20 ft. lengths will exhaust 250 cfm.; and each 3-in. hose over 200 cfm. The entire unit can be hung into a small manhole.—*Chelsea Fan & Blower Co., Inc., 1206 Grove St., Irvington, N. J.*

Bulletin Display Cabinet

This new unit is designed for better display of wartime safety and morale posters, instructions and special messages. Sturdily constructed of non-critical materials, the glass-front cabinet permits quick change of bulletin material through a novel but thoroughly practical design. It is illuminated and equipped with simple, trouble-proof hardware designed to give years of efficient service. A pivot joint at the top permits the cover to swing up and away from the back where it is retained in an open position by a hold-out latch so that the fibre posting board can be easily removed or replaced. Attractively finished in two-tone green enamel, the unit measures 32x25x3½ in. and is equipped with a glass sign with sandblasted letters reading "Safety Bulletins" or "General Bulletins."—*Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.*

Rust-Proof Paints

Wherever it is desired to use a satisfactory alternate for aluminum paint, two products, manufactured by the Rust-Oleum Paint Corp., have been found to give maximum results, the manufacturer claims.—*Rust-Oleum Paint Corp., Evanston, Ill.*

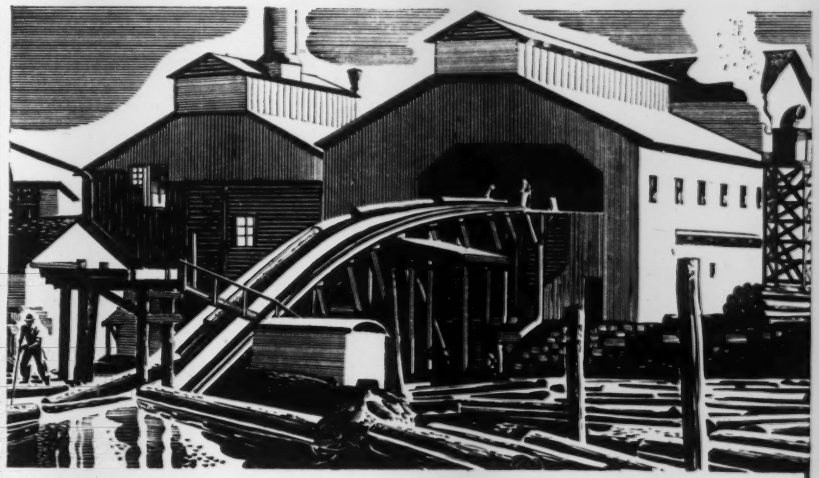
MANUFACTURERS' ACTIVITIES

C. D. BUCHER has been appointed director of purchases for the DAYTON RUBBER MANUFACTURING CO., succeeding J. C. Cunningham who resigned recently. Mr. Bucher has served two of the Akron rubber companies in the capacity of purchasing agent and buyer of engineering materials before coming to the Dayton organization. He is a graduate of Ohio State University, and a past president of the Akron branch of the National Purchasing Agents Association.

WILLIAM H. KNIGHT has been appointed director of sales and market research for the ELASTIC STOP NUT CORP. Mr. Knight has 20 years experience in sales and marketing activities. He was formerly vice president of Electric Household Utilities Corp., Chicago.

ALLAN D. SKINNER, 69, president of SKINNER ENGINE CO., Erie, Pa., died Dec. 4.

JESSE H. JONES, Secretary of Commerce, recently announced that the Rubber Reserve Co. has made a contract with the NATIONAL SYNTHETIC RUBBER CORP. for the operation of a new government-owned synthetic rubber plant to be built in Kentucky. The plant's output will be made generally available and allocated by the government. Formed for the specific purpose of operating this plant, the National Synthetic Rubber Corp. is jointly owned by five rubber companies: GOODALL RUBBER, INC., Trenton, N. J.; HAMILTON RUBBER MFG. CO., Trenton; HEWITT RUBBER CORP. of Buffalo, N. Y.; LEE RUBBER & TIRE CORP., Conshohocken, Penna., and MINNESOTA MINING & MFG. CO., St. Paul. President of the new organization is W. W. BENNER (left) of Lee Rubber & Tire Corp. Vice president is Dr. B. J. OAKES (right) of



This Wood Comes Back Home To Work
After Long Life Has Been Added

MANY LUMBER MILLS employ Wolmanized Lumber* on construction that is exposed to conditions conducive to decay—for log haul-ups, tramway supports and decking, conveyors, fuel bins and platforms. They cut their lumber to size, frame it ready for erection, and send it to a Wolmanizing plant for treatment. Then back to the mill it comes, prepared to give many years of service.

THAT'S CONVINCING evidence that the lumber producers think a great deal of this long-lived lumber.

WOLMANIZED LUMBER is ordinary wood that has been treated to make it highly resistant to decay and termite attack. Preservatives are driven deep into the wood by the vacuum-pressure method. "Fibre fixation" prevents their leaching out. Service records covering millions of feet, some of it in use over eighteen years, are evidence of its durability.

WARTIME STRUCTURES are being built of Wolmanized Lumber all over the world. The desirable properties of wood construction are retained—easy, fast erection, lightness, strength, resilience, good insulating properties. And long life is added, assuring low upkeep costs. Consider Wolmanized Lumber in your postwar planning. American Lumber & Treating Company, 1649 McCormick Building, Chicago, Illinois.

*Registered Trade Mark

WOLMANIZED LUMBER

FLEXPEDITE

Your Conversion—Assembly—Production

with

REX-WELD

Flexible Metal Hose

Rex-Weld Hose—Annular Corrugations

RW-80 Unbraided — RW-81 Braided

Rex-Weld Hose—Helical Corrugations

RW-90 Unbraided — RW-91 Braided

General Data

	STEEL	BRONZE
Sizes	To 4" I.D.	To 4" I.D.
Pressures	To 14,500 p.s.i.	To 14,500 p.s.i.
Temperatures	To 1000° F	To 450° F.
Lengths	To 50'	To 50'

Use Chart

	*STEEL	BRONZE
Saturated Steam		✓
Superheated Steam	✓	
Sulphur Bearing Oil	✓	
Oxygen		✓
Ammonia	✓	
Carbon Dioxide	✓	
Sulphur Bearing Grease	✓	
Critical Vibration		✓
Non-Sparking		✓

*Protective Coatings Can Be Applied for Corrosion Protection (To Conserve Critical Copper Bearing Alloys).

Couplings: REX-TITE Mechanical (Re-attachable) Couplings; Solder Couplings; Brazed and Welded Couplings and Flange Assemblies for Rex-Weld Flexible Metal Hose.

Ask for Engineering Recommendations

CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Ill.

the Minnesota Mining & Mfg. Co. Other officers include WILLIAM M. COLLINS, Jr., vice president and treasurer, and G. J. MOFFATT, Hewitt Rubber Corp., vice president.

B. P. SPANN, for the past eight years advertising manager of the GARDNER-DENVER Co. of Quincy, Ill., has been commissioned a lieutenant, junior grade, in the Supply Corps of the U. S. Naval Reserve, and has been stationed at Philadelphia, Pa. On leave of absence, Lieutenant Spann will resume his duties with the Gardner-Denver Company after the war.

Employees of the floor division of the factory, closure plant and general offices of the ARMSTRONG CORK CO. were told recently that they had set a remarkable record in converting to war production, on the award of the joint army-navy production pennant.

LANDERS SEVIER, 76 pioneer industrialist and civic leader of Birmingham, Ala. died there recently. He had been a vice-president of the SEABOARD AIRLINE RAILWAY, SLOSS SHEFFIELD STEEL & IRON CO., and general executive agent of the SOUTHERN RAILWAY SYSTEM.

GREDE FOUNDRIES, INC., has added to its holdings by purchasing the SMITH STEEL FOUNDRY CO. in Milwaukee, Wis.

D. W. HAERING & CO., INC., has announced the appointment of HOWARD B. GRAVES to the post of general manager of the company. Mr. Graves joined the organization in 1934 as senior technologist, and was formerly the St. Louis district manager. His wide background in the chemical engineering field is said to thoroughly qualify him for the new post.

The LINDE AIR PRODUCTS CO., supplier of oxyacetylene apparatus and electric welding equipment, recently was awarded the United States Maritime Commission "M" pennant. Other manufacturers sharing jointly in the award are the plants, factories, laboratories and offices of the PREST-O-LITE CO., INC., and the apparatus division, UNION CARBIDE & CARBON CO.

HARVEY S. OWEN, well known authority and chemist in the cement industry, and former deputy WPA state administrator

Heltzel

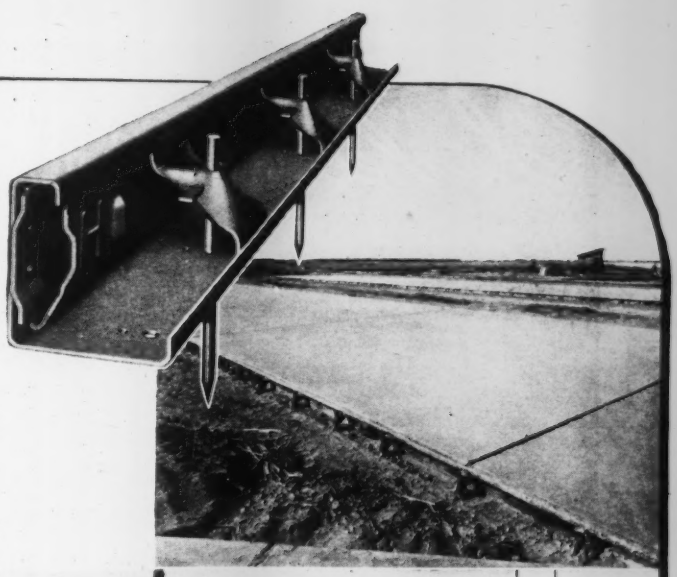
CONCRETE CONSTRUCTION EQUIPMENT . . . PERSONNEL . . . AND MANUFACTURING FACILITIES . . .

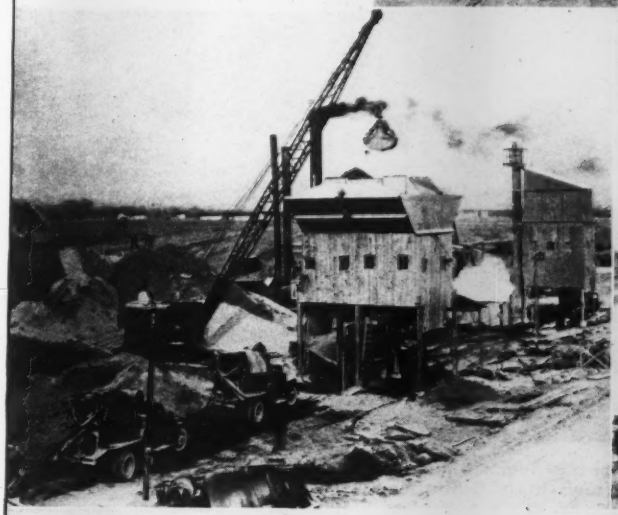
Has been dedicated 100 percent to the war effort . . . To the gigantic task of helping to provide our armed forces with better concrete airports, strategic military highways and access roads, munitions dumps, naval bases, training centers, etc. . . . ON TIME.

The superiority of Heltzel concrete construction equipment has been demonstrated on our peace-time projects and it is in demand in all parts of the world to help speed up our Victory Program. Our entire production is earmarked for vital war effort construction.

We are in a position to serve you in accordance with government regulations. *If your project is vital to the war effort, you can speed up your forming, batching or placing operations with Heltzel equipment.*

Write today for complete details.





HELTZEL SUPERIOR CONCRETE CONSTRUCTION EQUIPMENT

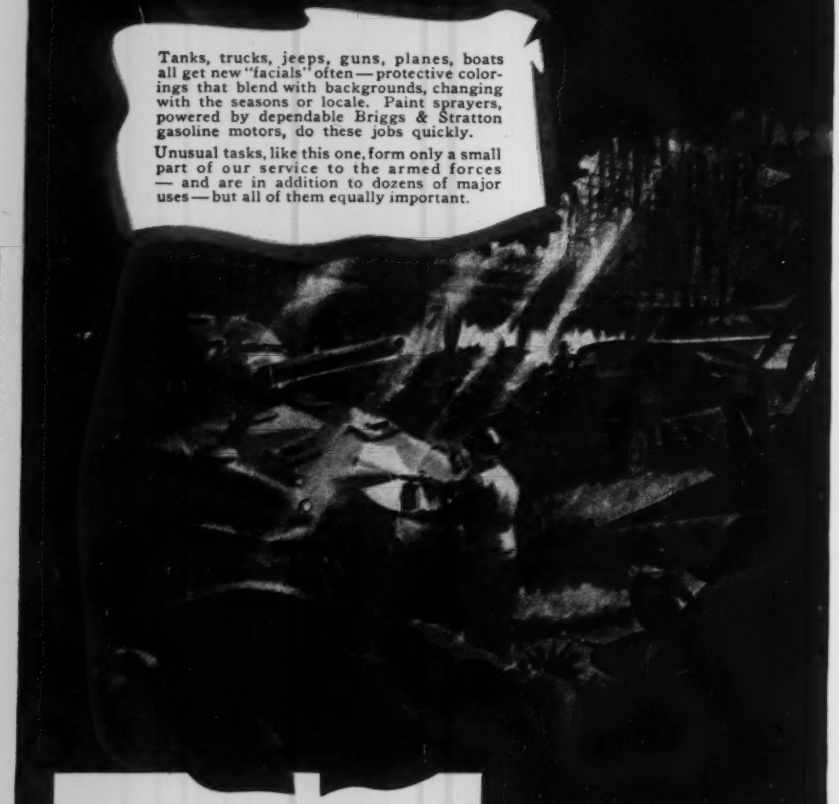
- MILITARY HIGHWAY FORMS
- AIRPORT FORMS
- CURB, CURB AND GUTTER OR SIDEWALK FORMS
- PORTABLE AGGREGATE BATCHING BINS — 30 TO 100 TONS CAPACITY
- PORTABLE AND SEMI-PORTABLE BULK CEMENT BATCHING BINS FROM 100 TO 750 BBLS. CAP.
- CENTRAL MIXING PLANTS
- CEMENT TANKS TO 1500 BBLS.
- CHUTING
- CONCRETE FLOOR HOPPERS
- CONCRETE BUCKETS

HELTZEL STEEL FORM & IRON CO.
WARREN, OHIO · U. S. A.

"Isabel" CHANGES HER MAKE-UP

Tanks, trucks, jeeps, guns, planes, boats all get new "facials" often — protective colorings that blend with backgrounds, changing with the seasons or locale. Paint sprayers, powered by dependable Briggs & Stratton gasoline motors, do these jobs quickly.

Unusual tasks, like this one, form only a small part of our service to the armed forces — and are in addition to dozens of major uses — but all of them equally important.



The war effort now requires the entire production of Briggs & Stratton 4-cycle, air-cooled gasoline motors, so they are available only to those who are serving the war program, or for approved "essential" civilian uses.

We'll do our best to serve you, if your product fits these classifications, or if you are planning post-war production of gasoline-powered appliances and equipment.

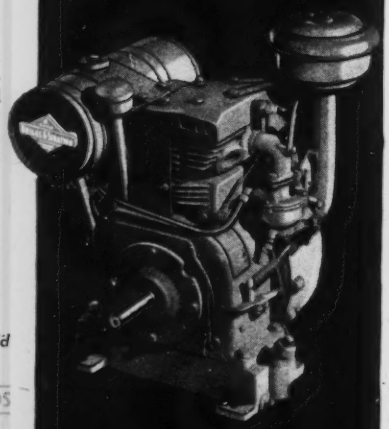
To conserve Briggs & Stratton Motors now in use, we urge operators to take extra precaution to see that each motor is correctly lubricated, properly adjusted and kept clean.

In case of emergency see your regular dealer or the nearest Authorized Briggs & Stratton Service Station.

BRIGGS & STRATTON CORP.
MILWAUKEE, WISCONSIN, U. S. A.

To help make this a better world to live in

BUY WAR BONDS



ARMY NAVY

4 CYCLE
BRIGGS & STRATTON
GASOLINE MOTORS

for Wisconsin, died Dec. 2 at Milwaukee. He was 56. A native of St. Louis, Mo., he was a graduate of the Missouri School of Mines and was state chemist of Missouri before coming to Milwaukee 18 years ago as engineer for the PORTLAND CEMENT ASSOCIATION and later for the E. D. CODDINGTON MFG. Co. At his death he was field engineer for the GEORGE S. MAY Co., of Chicago.

The BROWN FINTUBE Co., of Elyria, Ohio, manufacturers of resistance welded integrally bonded fintubes, and heat exchangers, has announced the appointment of B. DELORENZO as manager of the heat transfer department. Mr. DeLorenzo was formerly associated with the FOSTER WHEELER CORP., of New York, working as a laboratory technician and has been design engineer for the oil division since 1936. He is a graduate of the Massachusetts Institute of Technology, in chemical engineering.

E. A. SEELEY, manager of field personnel and training for the B. F. GOODRICH Co., has been loaned to the Army Ordnance Department's tank and automotive center, Detroit, Mich., as executive personnel adviser.

The HEIL Co. has announced the opening of a new service branch at 5743 Woodward Ave. Detroit, Mich., and of a new branch office in Suite 725 Fisher Building, Detroit.

For outstanding production of kingposts and condensers for the victory fleet the Dunkirk plant of the AMERICAN LOCOMOTIVE Co. recently was awarded the Maritime "M" pennant, the Flag of the Victory Fleet and the labor merit badges, in ceremonies held at Dunkirk, N. Y. HERMAN FRANCK, shown here, general superintendent of the plant conducted an official party through the plant after the ceremonies, to show how the outstanding job was done.

The RUSSELL & ERWIN MFG. Co., of New Britain, Conn., closely associated with the Maritime Commission since the prewar building of the S.S. America, recently was presented the "M" award of merit.

HARRY E. HOUGHTON, for the past five

Concrete that Defies Winter Pitting

KEEPS RUNWAYS AND HIGHWAYS SMOOTH

A way has been found to solve one of the concrete engineer's most troublesome problems. Concrete made with Vinsol-treated cement resists pitting and scaling caused by de-icing agents and the more frequent freezing and thawing entailed by their use. Air-field runways and highways can now be maintained in safe condition for traffic during northern winters without impairing their surface smoothness.

Saves Time and Money, Too

Vinsol-treated cement also saves time and money in placing, because the concrete is less subject to bleeding and segregation of the aggregate. It spreads faster and allows the finishers to hold to closer schedules by working nearer to the mixer.

Tests Convinced Everyone

It took years of testing in many states to convince highway departments and manufacturers of cement that a little Vinsol added to the cement at the clinker-grinding stage would produce these outstanding results. But the evidence is in. Slabs laid side by side, one with Vinsol-treated cement in the concrete, and one with normal cement, proved the case beyond question. Now leading cement companies are prepared to supply Vinsol-treated cement of normal or moderate heat types. Ask your regular supplier about it.

Interesting Book Free

In a 44-page booklet, "Better Roads Ahead," practical highway builders tell of their experiences with this material. Mail the coupon for your free copy.

Use "Vinsol-Treated" Cement
FOR
Reduced Surface Scaling

NAVAL STORES DEPARTMENT
HERCULES POWDER COMPANY
INCORPORATED
966 MARKET ST., WILMINGTON, DELAWARE

Gentlemen:
Send me a copy of 44-page book "Better Roads Ahead," telling the complete story of Vinsol-treated cements.

*Name*_____ *Title*_____
*Company*_____
*Address*_____
*City*_____ *State*_____ LL-6

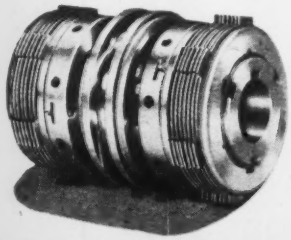
Concrete mixers on the move deal out about as much punishment to their component parts as you'll find in any piece of equipment anywhere. If the truck mixer is to successfully discharge its time-saving function, every part must stand up.

That's why the builders of the "MotoMixer" equip their line with Twin Disc Clutches . . . clutches which are recognized for their long wear-life.

In utilizing the experience and facilities which the Twin Disc Clutch Company has gained in a quarter of a century of building industrial clutches, this manufacturer protects his product from the results of untested clutch performance. At the same time, users of the unit are insured as fully as possible against lost time due to clutch failure.

If you contemplate the manufacture of any new type of material handling equipment, it will be worth your while to consult with Twin Disc engineers about your clutch requirements.

A Twin Disc Model MTU Duplex Multiple Disc Clutch running in oil is used on this concrete mixer. The clutch operating mechanism has a high clamping efficiency with a comparative low pressure on the control lever and a relative short travel—which assures high torque capacity with compact size and minimum clutch length.



TWIN DISC CLUTCH COMPANY • RACINE, WISCONSIN

years general sales manager of Brown Co., Berlin, N. H., producers of pulp, paper and other wood cellulose products, has been elected vice president in charge of sales. Previous to his connection with the Brown Co., Mr. Houghton was identified with the advertising agency business as vice president of Sherman K. Ellis Co., Inc., and Geyer Cornell & Newell.

PAUL J. NEWTON, formerly chief, excavating and grading section, Construction Machinery Branch, War Production Board, has been elected treasurer of HERTZLER & ZOOK CO., Belleville, Pa., machinery and industrial motorizing organization.

WILLIAM C. CARTER, for 14 years vice president and for the past year executive vice president of the LINK-BELT CO., has been elected president of the organization, effective Dec. 31, succeeding ALFRED KAUFFMANN, who resigned recently. Mr. Carter, a mechanical engineering graduate of the University of Illinois, joined Link-Belt in 1902 as a draftsman. He was consecutively held the positions of engineering department supervisor, construction superintendent, plant superintendent, plant general manager, vice president in charge of production.

L. A. FLAGLER has been appointed assistant general manager of the FRANKLIN BAKER division of GENERAL FOODS, effective Dec. 1.

FRANK AUGUSTUS KRONER, 60, of Decatur, Ga., Southeastern Transportation manager of the GENERAL ELECTRIC CO., died there recently.

ROGER W. ALLEN, district sales engineer for FOXBORO CO., at Atlanta, Ga., for the past six years, has been named southeastern district manager for WHEELCO INSTRUMENTS CO., Chicago. He will make his headquarters at 305 Techwood Drive, Atlanta.

Rear Admiral W. L. FRIEDELL, commandant of the Mare Island Navy Yard, presented the Army-Navy "E" award to employees of the COLUMBIA STEEL CO. at the company's Pittsburg works recently.

G. D. GILBERT, sales manager of the Baldwin-Duckworth division of the CHAIN BELT CO., has been made general manager of that division, and secretary of the company, succeeding A. R. ABELT, who became a vice president of the company recently.

FRANCIS MARSHALL, 48, chief engineer of

Here Is Your Nearest Worthington Distributor

For Sales, Rentals and Service on BLUE BRUTE Portable Compressors, Rock Drills and Air Tools. Get your EQUIPMENT-SAVER — FREE

see full page ad page 176

ALABAMA
Birmingham — Ed Gantt Machinery Company
ARIZONA
Phoenix — Smith Booth Usher Company
ARKANSAS—Fort Smith — R. A. Young & Son
Little Rock — R. A. Young & Son
CALIFORNIA
Los Angeles — Smith Booth Usher Company
COLORADO
Boulder — Standard Machine Works
CONNECTICUT
Hartford — The Holmes-Talcott Company
GEORGIA
Atlanta — Tractor & Machinery Co., Inc.
ILLINOIS — Chicago— Kennedy-Cochran Co.
Rock Island — Western Equipment & Supply Co.
INDIANA
Indianapolis — Reid-Holcomb Company
IOWA— Des Moines — Electrical Eng. & Constr. Co.
KENTUCKY — Harlan — Hall Equipment Sales
Louisville — Engineering Sales Company
LOUISIANA
New Orleans — Wm. F. Surgi Equipment Company
MAINE — Ellsworth — Murray Machinery Co.
MARYLAND
Baltimore — D. C. Elphinstone, Inc.
MASSACHUSETTS
Boston — P. I. Perkins Company
Cambridge — W. W. Field & Son, Inc.
Springfield — The Holmes-Talcott Company
MICHIGAN
Detroit — W. H. Anderson Company, Inc.
MINNESOTA
Minneapolis — The George T. Ryan Company
MISSOURI
Kansas City — Machinery & Supplies Company
St. Louis — Webster & Hedgcock Tr. & Eq. Co.
MONTANA— Helena — Caird Engineering Works
NEW JERSEY
Irvington — Smith Tractor & Equip. Co., Inc.
NEW MEXICO
Albuquerque — The Harry Cornelius Company
NEW YORK
Albany — Larkin Equipment Company
Binghamton — MacDougall Equipment Co.
Buffalo — Dow & Company, Inc.
Corona, L. I. — The Jaeger-Lembo Machine Corp.
Middleton — S. T. Randall, Inc.
New York—Hubbard & Floyd, Inc.
Olean — Freeborn Equipment Company
Oneonta — L. P. Butts, Inc.
Syracuse — Harrod Equipment Company
NORTH CAROLINA
Durham — Constructors Supply Company, Inc.
OHIO — Cincinnati — The Finn Equipment Company
Cleveland — Gibson-Stewart Company
Marietta — Northwest Supply & Equipment Co.
Toledo — M. W. Kilcorse & Company
OKLAHOMA
Oklahoma City — Townsco Equipment Co.
OREGON
Portland — Andrews Equipment Service
PENNSYLVANIA
Easton — Sears & Bowers
Harrisburg — N. A. Coulter
Oil City — Freeborn Equipment Company
Philadelphia — Metalweld, Inc.
Pittsburgh — John McC. Latimer Company
Wilkes-Barre — Ensminger & Company
SOUTH CAROLINA
Columbia — Bell-Lott Road Machinery Co.
SOUTH DAKOTA
Sioux Falls — Empire Equipment Co.
TENNESSEE
Chattanooga — James Supply Company
Knoxville—Wilson-Weesner-Wilkinson Co.
Memphis — Tri-State Equipment Company
TEXAS — Dallas — Shaw Equipment Company
Houston — McCall Tractor & Equipment Co.
San Antonio — Patten Machinery Company
VIRGINIA
Richmond — Highway Machinery & Supply Co.
WASHINGTON
Seattle — Star Machinery Company
WEST VIRGINIA
Fairmont — Interstate Engineers & Constructors
WISCONSIN
Eau Claire — Bradford Machinery Company
Green Bay — Nelson Machinery Company
Madison — Western Equipment Company
WYOMING
Cheyenne — Wilson Equipment & Supply Co.

Get more WORTH from air with WORTHINGTON

Buy Blue Brutes

Worthington Pump and Machinery Corp.

the Electric Sprayit Co., died recently at Sheboygan, Wis.

For the first time, both plants of the Cooper-Bessemer Corp., at Mount Vernon, Ohio, and Grove City, Pa., participated simultaneously in a single ceremony recently on the award of the Maritime "B", the Victory Fleet Flag, and a Maritime Merit Badge to the company for its war work. An inter-plant public address system was used to tie the plant workers up for the ceremony.

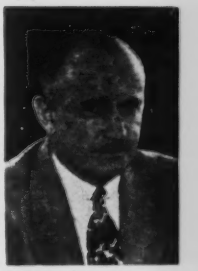
A. H. B. Jeffords, management engineer with the Trundle Engineering Co., for several years, has been promoted to the post of vice president, specializing in war production rules, regulations and requirements.

At a recent meeting of the board of directors of the Marion Steam Shovel Co., Marion, Ohio, John P. Courtright was named vice president in charge of sales. Since a year ago, Mr. Courtright has been director of sales for the company. His sales experience with the company dates to 1927 when he became a salesman in the Chicago district territory. In 1936 he was made district manager at Chicago and became sales manager over all districts in 1937.

Roderick D. Donaldson, formerly vice president of the Utility Management Corp., has become associated with Gibbs & Hill, Inc., consulting engineers, as head of a department to render advisory and supervisory services to operating utilities.

Jeff Corydon has resigned as president and director of Proportioneers, Inc., of Providence, R. I. Although the resignation is effective immediately, Mr. Corydon will continue at the Proportioneers address until March 11, 1943, and at his home.

H. O. Koch, chief clerk for the Austin Co. on a construction project in the Midwest, was on hand recently to act as master of ceremonies at the awards of a Treasury Minute Man Banner to company employees for 100 percent participation bond buying. W. R. Whitehead, Austin paymaster, accepted the banner from W. B. Harrison, local war bond chairman.



Carl G. Preis has been elected vice president of the American Can Co., in charge of engineering. Mr. Preis, who was formerly chief engineer of the company, is also vice president and general manager of the Amertorp Corporation, a wholly-owned subsidiary corporation engaged in the manufacture of naval and aerial torpedoes.

Excellence in production of war materials has won for the San Francisco yard of the Bethlehem Steel Co. the Army-Navy "E" award.

Harry G. Smith has been named operations manager of the Aircraft Parts Division of Reynolds Metals Co. Mr. Smith will superintend the opening and operation of five additional plant buildings that have just been leased by Reynolds to augment its expanding aircraft parts department at Louisville, Ky. Mr. Smith, formerly of the Hoosier Lamp and Stamping Co. of Evansville, Ind., will make his headquarters in Louisville.

H. A. Bransford, Jr., formerly sales engineer in the Service Bureau of Penn-Dixie Cement Corp., Richard City, Tenn., has been made director of the War Products Department of the same company.

The appointment of Robert H. Bishop, formerly eastern sales manager of the lighting division of Sylvania Electric Products, Inc., to the post of general sales manager of this division was announced recently by Don G. Mitchell, vice president and director of sales. Mr. Bishop takes over from Charles G. Pyle, who recently resigned to accept an appointment as managing director of the National Electrical Wholesalers Association. His headquarters will be at the company office in New York City.

Albert C. Delmont has been appointed research director of the newly organized research and laboratory departments of the Douglas T. Sterling Co., management consultants of Stamford, Conn.

The Flexcell Co. has moved its office from 919 North Michigan Avenue, Chicago, Ill., to a new location at 120 South La Salle Street, Chicago.

Reinhold W. Kroschinsky, 54, mechani-

VITAL IN WAR ESSENTIAL IN PEACE

NO OTHER LIGHT-WEIGHT PIPE GIVES YOU ALL THESE NAYLOR ADVANTAGES

- SAVES STEEL
- SAVES MONEY
- LIGHT IN WEIGHT
- EASIER TO INSTALL
- LEAK-TIGHT, SAFER
- ABSORBS SHOCK LOADS
- HANDLES JOBS NORMALLY REQUIRING HEAVIER-WALL PIPE
- CUTS MAINTENANCE
- CONNECTIONS TO FIT YOUR EXACT NEEDS

Sizes from 4″ to 30″ in diameter with all types of fittings and connections

MORE FOR YOUR MONEY With NAYLOR Light-Weight PIPE

Naylor's exclusive Lockseam Spiralweld structure creates a pipe that out-performs all other light-weight pipe. The spiral truss provides greater strength together with a safety feature which acts as a continuous expansion joint, cushioning vibration, stresses and strains. That's why contractors are able to use Naylor Pipe on jobs normally requiring heavier-wall pipe. And along with these advantages you get savings in transportation, handling and installation.

NAYLOR PIPE SERVICE

Dredging . . Hydraulic Sluicing . . Dewatering . . Ventilating . . Exhaust and Intake . . Gas Gathering . . Pulp Lines . . Vacuum Lines . . and other high or low pressure lines

Write for Naylor Catalog and Special Connections Bulletin

Naylor

NAYLOR PIPE COMPANY

1248 East 92nd Street, Chicago, Illinois

cal draftsman for the MILWAUKEE BRIDGE CO., Milwaukee, Wis., died December 23.

Continuing the high record of war production that earned the All-Navy "E" for them last April, employees of BRODERICK & BASCOM ROPE CO., St. Louis, Mo., have won a renewal star from the Army and Navy. The added star, affixed to a new joint service flag, denotes extension of the honor for another six months. Additionally the new Army-Navy "E" badge was given to the company employees to mark their having made good on their pledge of last April to continue a high production rate.

THE UNIVERSAL FORM CLAMP CO., has announced the removal of its plant and office from 972-982 Montana Street, Chicago, Ill. to 1238–48 N. Kostner Avenue, Chicago.

DR. ALBERT W. DAVISON, professor of chemical engineering and head of the industrial engineering curriculum at Rensselaer Polytechnic Institute, has joined the OWENS-CORNING FIBERGLAS CORP. as scientific director of its research laboratories at Newark, Ohio.

W. ROY WIDDOES has been named director of personnel relations for LUKENS STEEL CO. and its subsidiaries, at Coatesville, Pa. Mr. Widdoes succeeds Charles L. Huston, Jr., who was recently made assistant to the president. At the time of his appointment, Mr. Widdoes was general manager of BY-PRODUCTS STEEL CORP., a Lukens subsidiary. He had been an employee of the company since 1912.

JOHN COOLIDE DAVENPORT, pioneer designer of electrical starters and large transformers, and head of the contacts division of the ALLIS-CHALMERS MFG. CO.'s electrical department at Milwaukee, Wis., died recently.

ARTHUR V. MILLER, superintendent of the SOUTHERN GAS LINE, INC. and formerly commissioner of parks and streets for the city of Monroe, La., died recently at Monroe.

The COOPER-BESSEMER CORP., praised for its outstanding production of diesel engines and major engine parts for Liberty ships, recently was awarded the Maritime "M" flag by the U. S. Maritime Commission.

GLEN W. SHETLER, for many years connected with steel plants in the Canton,

Copyright 1942 by American Mutual Liability Insurance Company

Haste Need Not Make Waste

Conditions which make for accidents that handicap your operations . . . are growing steadily worse

HASTE is imperative, for our war effort needs new construction . . . yet haste invites accidents. Your experienced men are leaving for service . . . and green men are more apt to get injured. New types of equipment . . . the substitute materials you are sometimes forced to use . . . the lack of trained foremen — all add to the difficulty of keeping work safe.

A POTENT ALLY AGAINST ACCIDENTS

Faced with a problem full of new complications, more and more contractors have turned to American Mutual for aid in combatting this threat to efficient work.

American Mutual has specialized for many years in safety services for contractors. Our field representatives and safety consultants have contributed to the successful completion of thousands of building enterprises and today are on the job from Maine to Texas — helping to guard our war projects from delays and losses due to accidents.

American Mutual not only will help you establish proper and proven controls for your special conditions but will also provide as close a follow-through as those conditions require. We urge you, in the interests of fulfilling your part in the war, to insist upon the thorough accident-prevention service that only a firm with American Mutual's experience can be expected to provide.

In addition, you, like all contractors who have ever insured with American Mutual, have the opportunity to save at least 20% of premium costs.

FREE BOOK FOR FOREMEN!

Valuable information for new foremen . . . "refresher" material for experienced foremen. Write for "Foremanship" to American Mutual, Dept. O19, 142 Berkeley St., Boston, Massachusetts.

American Mutual Liability Insurance Company

AMERICAN MUTUAL — WORKS FOR YOUR SAFETY

Admitted Assets	$47,908,092.19
Liabilities	40,659,020.90
Surplus to Policyholders	7,249,071.29

As of December 31, 1941

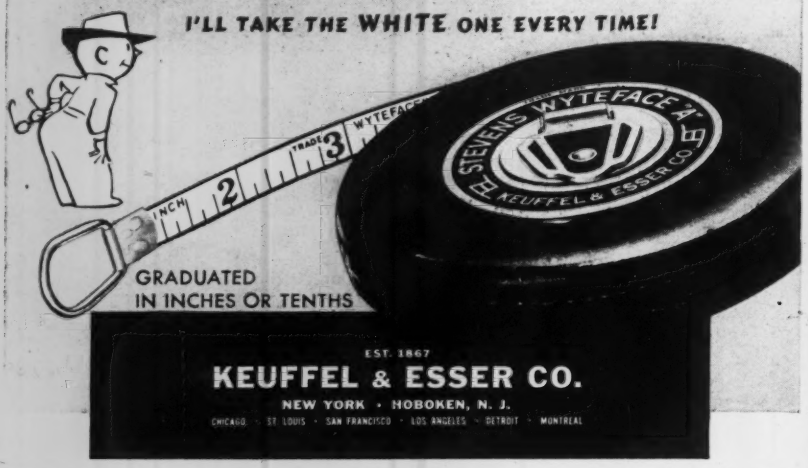
WYTEFACE "A"

TRADE-MARK

STEEL TAPES

K&E REG. U. S. PAT. OFF.

Easy-to-read, *raised* black graduations on crack-proof white surface ... resist abrasion from rock, sand, scraping over rails, pipe, concrete, etc. In all sizes and types—in cases or reels. Ask your dealer—or write for catalog.


I'LL TAKE THE WHITE ONE EVERY TIME!
GRADUATED IN INCHES OR TENTHS
STEVENS WYTEFACE "A"
KEUFFEL & ESSER CO.
EST. 1867
KEUFFEL & ESSER CO.
NEW YORK · HOBOKEN, N. J.
CHICAGO · ST. LOUIS · SAN FRANCISCO · LOS ANGELES · DETROIT · MONTREAL

COMMERCIAL TUNNEL LINERS

for

WATER TUNNELS
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SERVICE TUNNELS
HIGHWAY TUNNELS
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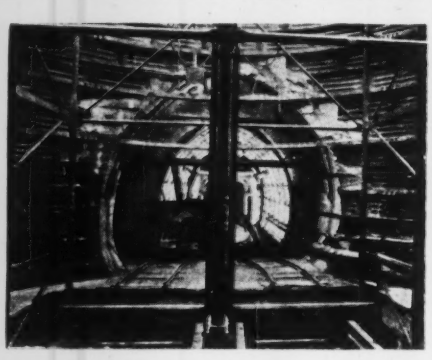
SHAFTS
MINE ROOFS
OVERCASTS



Use COMMERCIAL Liner Plates for every tunnel purpose and ground condition—COMMERCIAL Liner Plates and Supports can be furnished for any size and shape of tunnel.

Use of these plates means real safety. The tough, yet flexible steel, bolted together into a continuous skin receives and disperses loads over the whole structure. Assure safety, economy, and speed. Use COMMERCIAL Liner Plates—write to us for complete details on its application to your jobs.

THE COMMERCIAL SHEARING & STAMPING CO.
YOUNGSTOWN **OHIO**

Ohio, area and later an official of the CRUCIBLE STEEL CO., Syracuse, N. Y., has become general manager and production manager of the BARIUM STAINLESS STEEL CORP. at Canton.

GEORGE HAISS MFG. CO., INC. has recently appointed HARRON, RICKARD & MCCONE CO. of San Francisco as its San Francisco distributor.

In recognition of its employees' "practical patriotism" as exemplified by the rate they are producing war goods, the ST. MARYS MFG. CO. at St. Marys, Ohio, has been awarded the Army-Navy "E" flag.

PERCY E. RHICARD, works tool engineer at the East Springfield plant of the WESTINGHOUSE ELECTRIC & MANUFACTURING Co., recently received his company's highest award for work in designing tools for production of ordnance equipment for the U. S. Army. Presentation of the Westinghouse Order of Merit was made on December 12 by J. H. ASHBAUGH, manager of the company's electric appliance division at Springfield, Mass. A certificate accompanying the medal cited Mr. Rhicard for his exceptional ingenuity in devising and designing tools for difficult and unusual operations, and specifically for creative work in both tool methods and design on bomb fuses for the U. S. Government.

HUGO LOUIS DEIL, assistant to the president of the WAUKESHA MOTOR CO., of Waukesha, Wis., and the oldest employee of the firm, died recently at his home there.

Award of the Army-Navy "E" flag to WARREN WEBSTER & CO., of Camden, N. J., pioneer manufacturers of steam heating equipment, was announced recently in a letter received from the War Department.

The Army-Navy "E" award for outstanding achievement in war production was presented recently to the 9,662 employees of the AMERICAN OPTICAL CO. at a ceremony held in the company's Southbridge, Mass., plant.

Something unusual in the way of awards to manufacturers for their assistance to the nation's war effort was the recent citation given the BARRETT DIVISION of the ALLIED CHEMICAL & DYE CORP., of New York, for an advertisement placed in national magazines showing how money obtained from war bonds is used directly to save lives of the nation's fighting forces.

Happy Landings

Be sure OF AIRPORT RUNWAY AND HIGHWAY PAVING PERFECTION WITH *Keystone* PRODUCTS

Keystone Products used in the typical paving job shown above give the contractor lower cost, easier handling and quicker delivery. They are waterproof and will never rust.

THERE's a pleasant feeling for the pilot as he brings his high speed pursuit ship or bomber in for a landing. It's swell to know that the smoothly paved runway looming up so speedily will assure another "Happy Landing."

There is no cracking or humping of concrete when Keystone Asphalt Mastic Center Strip and Expansion Joints are used. The trapezoidal tongue-and-groove joint provides maximum load transmission. The modern improved paving method that saves thousands of tons of steel for its war job and does the paving job better.

WRITE FOR COMPLETE INFORMATION TODAY!
JUST FILL IN AND MAIL THE COUPON

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ASPHALT PRODUCTS COMPANY
(A Division of the American-Marietta Company)
43 E. OHIO STREET . . . CHICAGO

KEYSTONE ASPHALT PRODUCTS COMPANY
43 E. Ohio Street, Chicago, Illinois

Please send me complete information on Keystone Asphalt Products.

Name_____
Street_____
City_____ State_____

Guard precious war drawings with this special-process tracing cloth

Mistakes mean delays, and America's wartime job is to *speed* production! Give war jobs the best! That means specially-processed Arkwright Tracing cloth. Arkwright is made by a highly technical method on costly machines. The surface is clear, smooth – never "humpy." Ink lines won't spread or "feather" – nor crack or chip in drying. Years from now, drawings will be fresh and clear – truly permanent! Guard your war work this way. Arkwright Finishing Company, Providence, R. I.

Arkwright TRACING CLOTHS

AMERICA'S STANDARD FOR OVER 20 YEARS

BAILEY METERS AND CONTROLLERS

FOR SEWAGE TREATMENT AND WATER SUPPLY . . .

● Venturi Tubes, Weirs, Flumes, Nozzles and other primary elements; Mechanically and Electrically operated Registers and Complete Automatic Control Systems.

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Bailey Meter Co. Ltd., Montreal, Canada

MITCO

OPEN STEEL FLOORING

Pressure Formed
90% Open Area

Easy to Install

Hendrick Manufacturing Company
45 Dundaff Street, Carbondale, Pa.

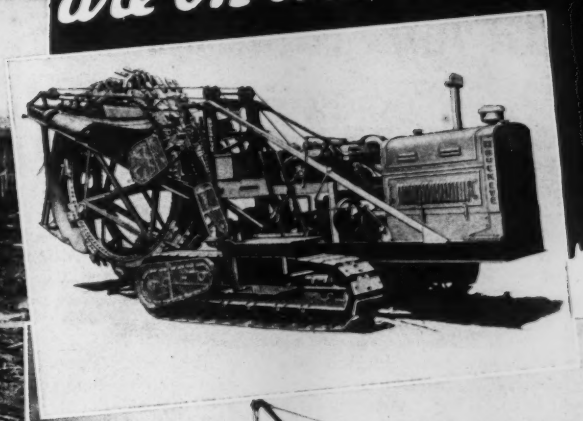
Conveyors—A new pictorial folder describing the products of the Metzgar Co., manufacturers of gravity wheel conveyors, power belt conveyors, end-wood wheel casters and end-wood truck wheels, has just been issued.—*Metzgar Co., Grand Rapids, Mich.*

Repair—Methods of keeping Lorain machines repaired are described in a new 24-page booklet published by the Thew Shovel Co. The booklet sets forth not only the best method of meeting emergencies in the field but provides a guide in the use of substitutes for critically hard to obtain materials. It tells Lorain users how to reshape tread pin holes, build up tread teeth, what material to use as a substitute for replacement bushings and much other information. Clear and fully explained illustrations add to the clarity of the text.—*The Thew Shovel Co., Lorain, Ohio.*

Gages—Three new technical bulletins, one describing the company's SR-4 strain gage and the other two the recording and indicating instruments for use with SR-4 strain gages, have been issued by the Baldwin Southwark Division of the Baldwin Locomotive Works. The bulletin on SR-4 strain gage which describes an entirely new and revolutionary method for determining stresses in structures and machines, gives detailed descriptions of the three standard gages, their application in measuring and recording dynamic and semi-dynamic strains, and instructions for installing the gages on structures to be analyzed. Contained in the two other technical bulletins, the SR-4 strain recorder and the SR-4 portable strain indicator, are detailed descriptions of the instruments and installation operating information for their use.—*The Baldwin Locomotive Works, Baldwin-Southwark Division, Philadelphia, Pa.*

Safety—The American Optical Co. has announced a new publication—*The Safety Clipper*—for use by editors of employee newspapers or magazines in promoting industrial safety. The first issue, just published, is designed to provide editors with information, articles, cartoons and editorials on the importance of industrial safety. By reprinting the materials appearing in the miniature newspaper, those in charge of employee publications can help persuade workers to use the goggles, protective clothing and safety devices

Buckeye Trenchers are on the Warpath!



All over this hemisphere Buckeye Trenchers are at work rushing war jobs—speeding digging of trench for water, sewage, drainage, foundation footings, electric and telephone cable and even central heating plant steam ducts at army camps, pilot training centers, air bases and ordnance plants.

Less conspicuous, but no less important, Buckeyes are also digging trench for much needed petroleum pipelines to replace tankers that have been placed in foreign service and to ease the burden on railroads. And they are digging trench for irrigation and drainage to reclaim rich land —for food wins wars, too.

There's a Buckeye for every trenching requirement; rotary digging wheel and ladder types. They dig trench from 11½" wide to 5½′ deep (Model 11) and up to 12′ wide and 24′ deep (Model 260). Every Buckeye Trencher built today goes directly to a job where it can do the most to insure our victory.

BUCKEYE TRACTION DITCHER CO., FINDLAY, OHIO

Built by Buckeye

vertible Shovels | Trenchers | Tractor Equipment | R-B Finegraders | Road Wideners | Spreaders

An Important Message to

Technical Men

The war has carried the manufacturing age to a new peak! Production demands have created technical problems the like of which the world has never seen before! The services of engineers are at a premium. Especially the services of one particular class—executive engineers—*engineers with business training;* engineers who can "run the show."

In these critical times, the nation needs engineers of executive ability *now, today*—not five, or ten years from now! The shortage of such men is acute—even more acute than that of skilled production workers. And company heads, aware of this situation, are offering high rewards to engineers who have the necessary training in industrial management.

Golden Opportunity for Engineers

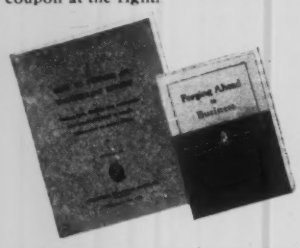
In this new era, the engineer with vision and foresight has a golden opportunity. He will realize that out of today's tremendous production battles will emerge technical men who not only will play a major role in winning the war, but who also will be firmly entrenched in key executive positions when peace comes.

However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other divisions of business—of marketing, accounting and finance. He has of necessity a vast amount of technical training and experience. But in order to grasp the opportunities that present themselves today—to assume leadership on the production front—he must *also* have an understanding of practical business principles and methods.

The Alexander Hamilton Institute's intensive executive training can give you this essential business training to supplement your technical skill.

FREE help for engineers

Ever since the war began, there has been an unusually heavy demand on the part of our technically-trained subscribers for the Institute's special guide on "How to Prepare an Engineering Report". Extra copies of this practical, helpful 72-page Guide are now available and, for a limited time only, will be sent free to all technical men who use the coupon at the right.



134,000 men on the operating side of business have enrolled for this training. More than 37,500 are technical men—engineers, chemists, metallurgists—many of whom are today heads of our huge war industries.

This training appeals to engineers because it gives them access to the thinking and experience of the country's great business minds. It is especially valuable to such men because it is basic, not specialized—broad in scope, providing a thorough groundwork in the fundamentals underlying *all* business. It covers the principles that every top executive must understand. It applies to all types of industrial organizations, because all types of organizations are based on these same fundamentals.

Business and Industrial Leaders Contribute

The Institute's training plan has the endorsement of leading industrialists and business men. And it is only because these high-ranking executives recognize its value and give their cooperation that such a plan is possible. Among those who contribute to the Course are such men as Frederick W. Pickard, Vice President and Director, E. I. DuPont de Nemours & Co.; Thomas J. Watson, President, International Business Machines Corp.; James D. Mooney, President, General Motors Overseas Corp.; Clifton Slusser, Vice President, Goodyear Tire and Rubber Co. and Colby M. Chester, Chairman of the Board, General Foods Corp.

Send for "FORGING AHEAD IN BUSINESS"

The facts about the Institute's plan and what it can do for you are printed in the 64-page book, "Forging Ahead in Business". This book in its own right is well worth your reading. It might almost be called a handbook of business training. It is a book you will be glad to have in your library, and it will be sent to you without cost. Simply fill in and mail the attached coupon *today*.

Alexander Hamilton Institute, Inc.
71 West 23rd Street, New York, N. Y.
In Canada, 54 Wellington St., West, Toronto Ont.
Please mail me a copy of the 64-page book—"FORGING AHEAD IN BUSINESS" and also a copy of "HOW TO PREPARE AN ENGINEERING REPORT," both without cost.

Name.....

Business Address.....

.....

Position.....

Home Address.....

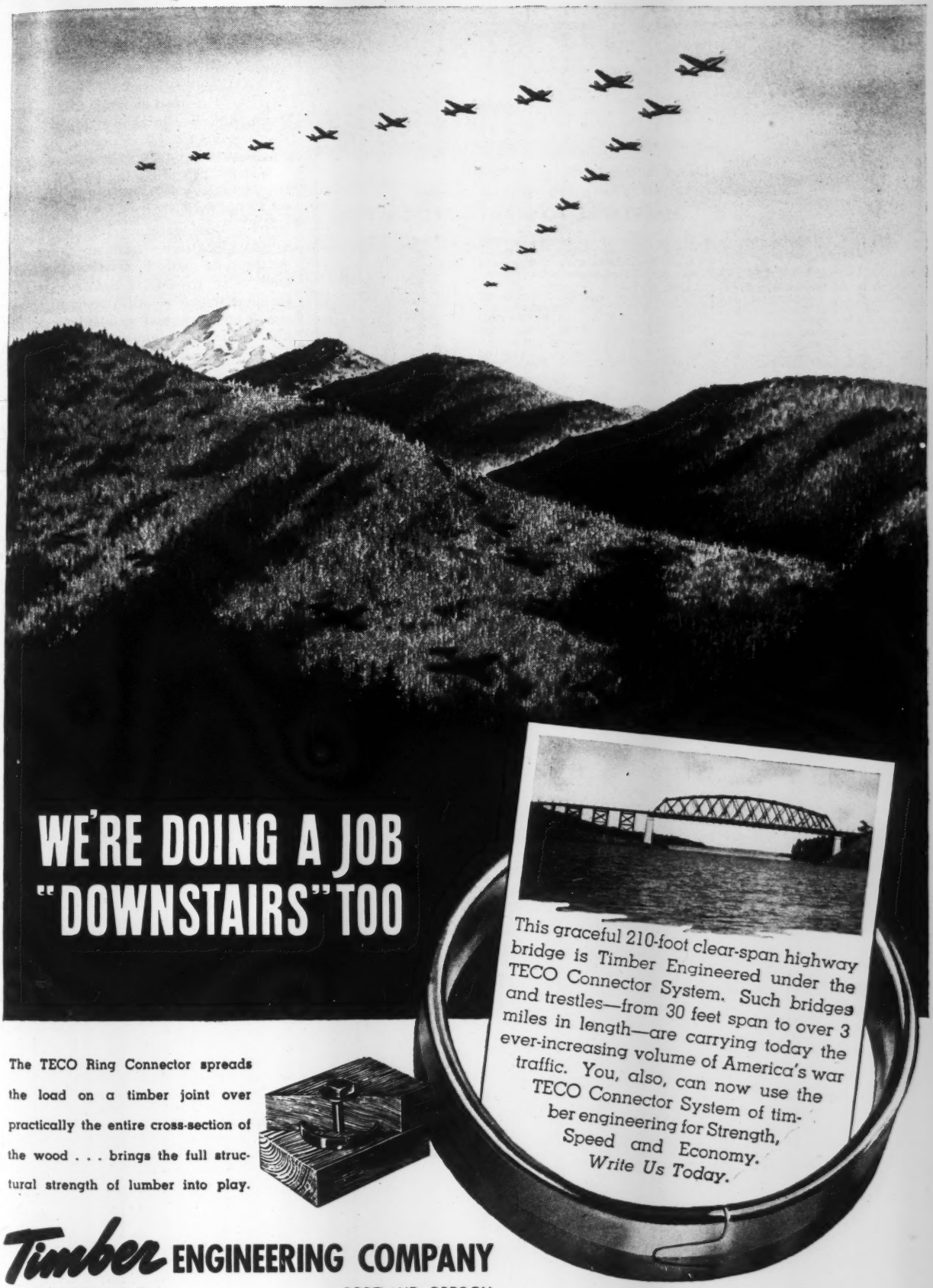
supplied to them.—*American Optical Co., Southbridge, Mass.*

Welding—Speed is increased 20 percent to 30 percent and power costs are cut one-third with the Flexarc a-c welders described in a new booklet issued by the Westinghouse Electric & Mfg. Co. The 12-page booklet compares advantages of a-c and d-c welding. A-C welders increase output because of the absence of magnetic arc blow, ease in using heavy electrodes with higher currents, and ability to make good welds in all positions.—*Department 7-N-20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Steam Generator—A 6-page folder describing the preferred unit steam generator has been issued by Preferred Utilities Co., Inc. This unit, being built for the last six months, for U. S. war agencies, is a heavy duty, self contained, oil fired portable steam plant embodying in one compact unit all the equipment necessary to produce steam. Simplicity is evident in all operating controls. The Preferred Unit steam generator is not a critical unit designed for use by only highly skilled technicians but is built to operate safely with an absolute minimum of attention and under the most inexperienced supervision. The folder gives complete diagrammatic details of the construction and specifications of the unit.—*Preferred Utilities Co., Inc., 33 West 60th St., New York, N. Y.*

Drive Control—For use where wide speed range or close regulation is required, the Rototrol, a versatile d-c drive control, is described in a new booklet by Westinghouse Electric and Manufacturing Co. The 14-page booklet "A Challenge to Designers of Drive Control" describes how Rototrol increases the speed range, keeps the speed of a direct-current motor constant regardless of load variations; makes accurate or very close speed regulation possible; gives uniform acceleration and deceleration; and maintains constant horsepower and uniform tension. Charts, diagrams and photographs explain how the Rototrol regulates by transposing mechanical and electrical quantities. Typical applications are described and illustrated.—*Westinghouse Editorial Service, East Pittsburgh, Pa.*

Forest at War—Just published by the Timber Engineering Co. is *"The Forest Fights"*, a book of news pictures showing the jobs the Forest Industries have done and are doing to forward the nation's war effort. Containing some 200 photographs, with brief descriptive copy, the 48-page book takes the reader from action shots at the front through the supply line and training camps, to industry and war housing on the home front. In



WE'RE DOING A JOB "DOWNSTAIRS" TOO

This graceful 210-foot clear-span highway bridge is Timber Engineered under the TECO Connector System. Such bridges and trestles—from 30 feet span to over 3 miles in length—are carrying today the ever-increasing volume of America's war traffic. You, also, can now use the TECO Connector System of timber engineering for Strength, Speed and Economy. *Write Us Today.*

The TECO Ring Connector spreads the load on a timber joint over practically the entire cross-section of the wood . . . brings the full structural strength of lumber into play.

Timber ENGINEERING COMPANY

WASHINGTON, D. C. PORTLAND, OREGON

EVERY ENGINEER
Should Get the Facts
ON NEW
"PERFORMANCE PLUS" PUMP...

ECONOMY TYPE SCV PUMP
for clear liquid service
ADAPTABLE TO MANY APPLICATIONS

This is a valuable catalog—get your copy

Send today for Catalog D2-1042 giving complete story on new type SCV pump. Tells about wide application possibilities and its many advantages. Gives dimensional and selection tables—shows typical assembly section.

★

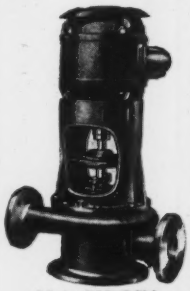
Also new pump Data Book Sent FREE

★

This 256-page engineering hand book contains all data required for the solution of most pump problems. Written in simplified form—anyone interested in pumps will find it valuable.

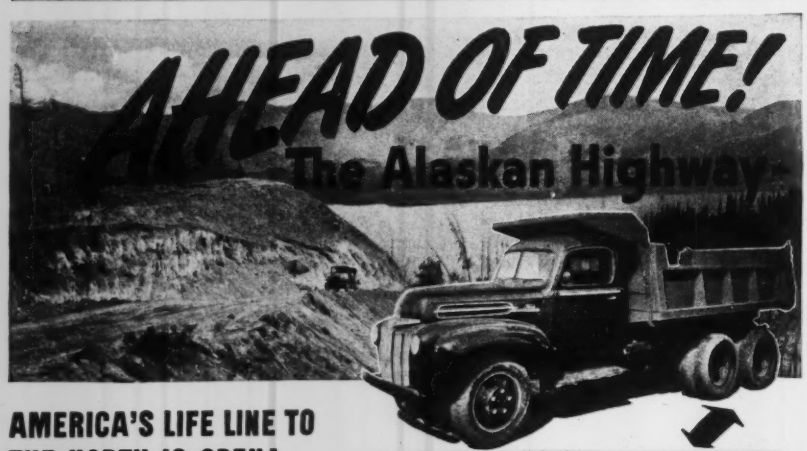
● Thirty years of experience is back of this medium priced, compact, efficient, and quiet operating pump. Practical features suggested by maintenance men and engineers are embodied in the design. Hundreds are in service now demonstrating DURABILITY — LOW MAINTENANCE —DEPENDABILITY. SCV pump has both outboard and inboard bearings assuring correct alignment, smoother and noiseless operation. Much less floor space required . . . it's much easier to clean pump and surroundings. And too, the SCV need never be idle because of motor trouble . . . simple machining of any suitable motor and your pump is again in operation.

We also make Vertical Sewage Pumps for open shaft settings—Vertical & Horizontal Axis Flow Pumps—Hoffman-Economy Condensation Pumps—Multi-stage Pumps—Hoffman Economy Return Line Vacuum Pumps—Double Suction Pumps—Horizontal and Vertical Sewage Pumps—Vertical Direct Connected Paper Stock Pumps—Submerged Type Sewage Pumps.



10 to 500 GPM
Motors are high above floor with mounting base away from dust, dirt, and splash. Pump rotor is easily accessible and removed without disturbing suction or discharge connections.

Economy Pumps Inc.
1015 WELLER AVE. HAMILTON, OHIO

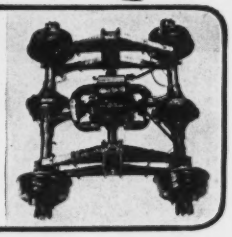


AMERICA'S LIFE LINE TO THE NORTH IS OPEN!—

A tough assignment in rough country calling for husky, durable, efficient equipment — and right on the job is a big fleet of trucks with——→

Standard heavy-duty trucks are not available today — but here is the answer to that problem. You can convert new or used 1½ to 3-ton trucks to husky, reliable heavy-duty units of more than twice the capacity. They actually do the job better and cost less.

THORNTON Four-Rear-Wheel DRIVE



THORNTON TANDEM CO.
8729-8779 GRINNELL AVE. DETROIT, MICH.
Manufacturers also of the THORNTON automatic-locking DIFFERENTIAL
"When you need TRACTION you need THORNTON"

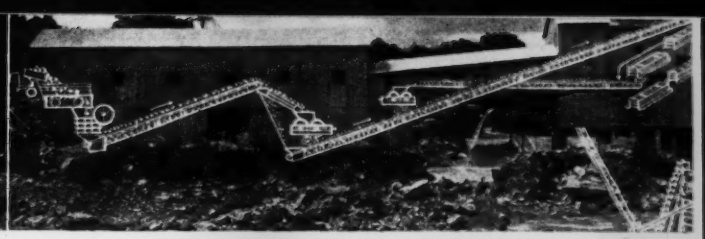
all the pictures wood is shown in some war use. Other chapters show uncommon or revised uses of wood, improved engineering methods in timber, research that is developing broader uses for wood, and the equipment and methods that are protecting the forests against fire.—*Timber Engineering Co., Washington, D. C.*

Water —"Conditioning Feed Water for High Pressure Boilers" is the title of a paper by Austin C. Dresher, an authority on boiler feed water conditioning. In this article, Mr. Dresher sums up the requirements to be made in conditioning boiler feed water, as well as the discussion on the importance of scale removal, corrosion, carry-over and embrittlement. The different methods employed in feed water conditioning are discussed, such as the hot process softener, the reduction of silica, and other methods. The paper is a resume of the art of feed water conditioning written in plain language, easily followed and understood by operating engineers.—*Distributed by Cochrane Corporation, 17th and Allegheny Ave., Philadelphia, Pa.*

Gluing—Now that many types of wood glues for aircraft, truck bodies, laminated arches and other wartime wood developments are in wide use, often being handled by men without long experience in gluing, there is a need for a brief, nontechnical handbook to help glue foremen and inspectors keep the "bugs" out of the gluing procedure. Aimed at this purpose, the Casein Co. of America has issued a new booklet called "The Casco Trouble Shooter for Joint Gluing." The 21-page booklet gives in simple language such details as common gluing faults and their remedies, the mechanics of casein and resin glue, methods of identifying the cause of a poor glue joint, tables for application of glue to varying surfaces, and other materials.—*Casein Company of America, 350 Madison Ave., New York, N. Y.*

Labels—The Ever Ready Label Corporation is continuing its series on war production labels, with a new issue of Bulletin No. 2 ready for distribution. Shown in the bulletin are labels used by outstanding war production plants and many others. Also available free on request is the company's catalog of 528 label ideas said to be full of time- and labor-saving suggestions that can be adapted by practically every type of organization.—*Ever Ready Label Corp., 141 East 25th St., New York, N. Y.*

THE Koppers Company, of Pittsburgh, Pa., has advertised for 2,000 construction workers to begin construction immediately on a large plant to supply materials for synthetic rubber production. The new plant will be located in Pennsylvania.



Rock Plants AS YOU LIKE THEM

No two rock jobs are alike. They vary in material — in the size of the feed — and the size and number of sizes in the product. Some rock must be washed — some rock is hard and brittle — others are tough — and some is soft.

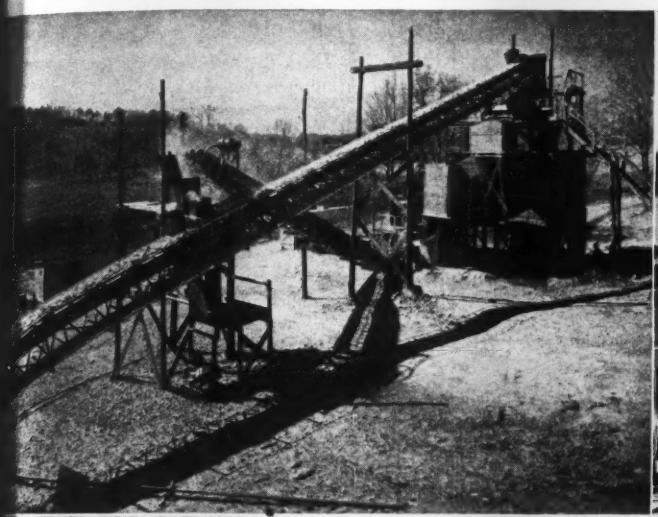
In one case, screening is the big problem — and in others it is crushing.

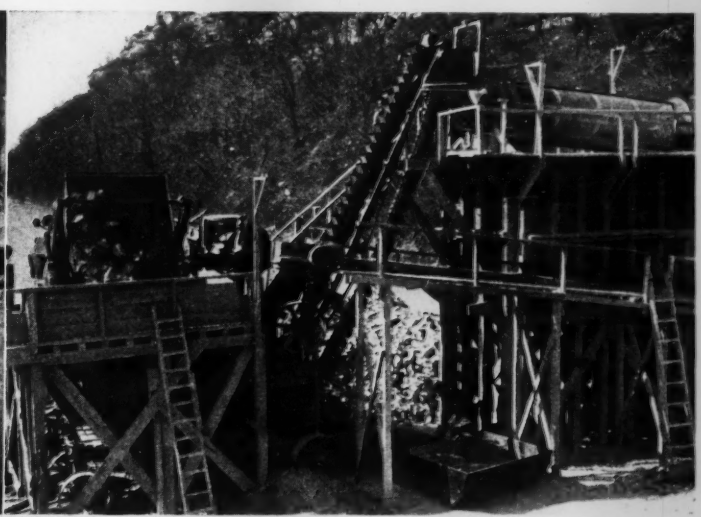
For *your* rock job, you want a plant that is tailored to your problem.

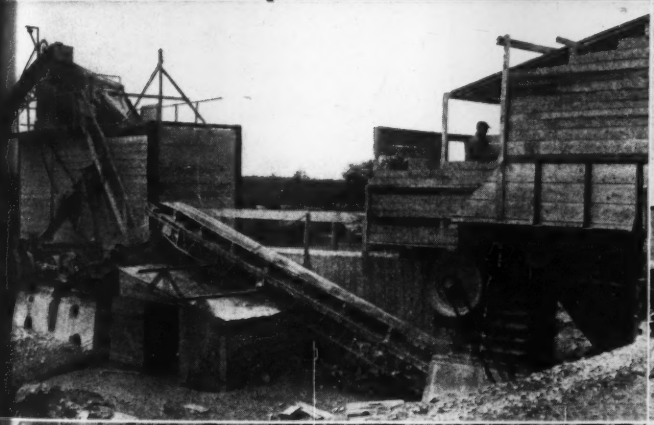
That is where Pioneer can help you. Pioneer Rock Plants are tailor made to suit the particular requirements of the job. Standard Pioneer Units are used — jaw crushers — roll crushers — screens — conveyors — elevators — and bins.

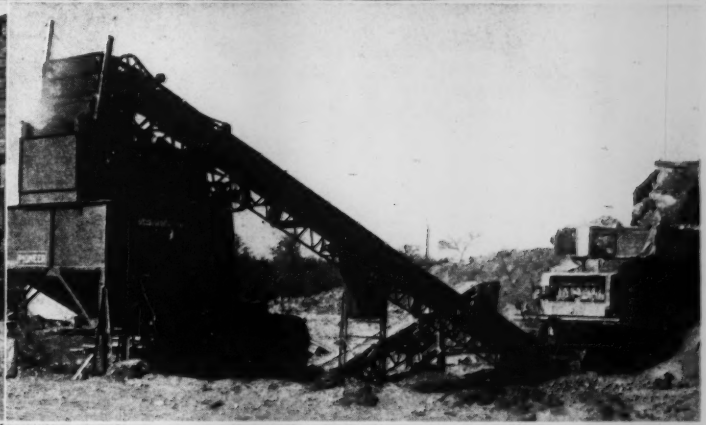
Tell us your rock problem. We will make a preliminary layout of a plant to suit your conditions. It will be submitted to you for revision and consideration. After approval, we will make finished installation and foundation drawings.

Furthermore, a Pioneer Rock Plant is complete with power drives, and all accessories. It is fully engineered and factory built — yet tailored to your job — and there is no cost for this Pioneer Engineering Service.









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ENGINEERING WORKS

Minneapolis, Minnesota, U.S.A.

Tanks produce results only in actual combat on the firing line.

To conserve their fighting capacity they ride to battle on Rogers Trailers, or if damaged are transported to the rear for repairs on a retriever type of trailer especially equipped to load disabled tanks.

Meanwhile, thousands of standard Rogers Trailers are serving efficiently on our factory fronts or in transporting defense equipment to various fortifications.

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Hayward Buckets

Use this Class "E" Clam Shell Bucket for handling crushed stone, gravel, sand and other bulk materials.

THE HAYWARD CO., 48-50 Church St., N. Y.

MEN AND JOBS

Lieut. Everett R. Reney, group engineering officer at the Waycross, Ga., Army Airport, has been promoted to captain.

Four officers are leaving the Plum Brook Ordnance Works at Sandusky, Ohio, having been assigned to field service. They are **Capt. N. B. Braskat** and **Lieut. C. E. Martinson, J. L. Lilly** and **G. L. Wander.**

James E. Fox, city engineer of Wooster, Ohio, has been commissioned a lieutenant in the Civil Engineering Corps of the U. S. Navy.

Lt. Col. H. C. Gee has succeeded **Col. A. G. Viney** as district engineer for the U. S. Engineers at Jacksonville, Fla. Colonel Viney, district engineer since November, 1941, has been transferred to an undisclosed assignment.

George Wallace and **Harry Piper,** first and second city engineers of Massillon, Ohio, have requested leaves of absence for the duration of the war to permit them to engage in defense work.

Clovis J. Harkrider, engineer for the Federal Works Agency at Wort Worth, Tex., has been transferred to the Federal Public Housing Authority as a senior engineer.

Harold Omsted, formerly an engineer and instructor for California Institute of Technology, is now a lieutenant commander in the U. S. Navy Reserve, serving overseas with a battalion of Seabees.

Charles B. Whitnall, pioneer city planning expert who retired about a year ago on a pension, has been made a member of the Milwaukee county planning commission under suspension of the rules.

William S. Walker, who served as administrative officer and technical assistant to the senior salvage engineer at Pearl Harbor, T. H., and was disabled in line of duty and honorably discharged, has become production engineer for the Dravo Corp. at Pittsburgh, Pa.

Richard Salmon, formerly airport engineer with Pan American Grace Airways, is now construction superintendent on construction of a Merchant Marine Academy in Great Neck, N. Y.

C. L. Bell, formerly resident manager for the Lummus Co., designing engineers and constructors at Syracuse, N. Y., has been transferred to Houston, Tex., to take charge of construction of a manufacturing plant there. Before being assigned to Syracuse, Mr. Bell had been general

Easy to Answer!

▸▸ *Question:* What is the safe, quick, economical way to handle a load that is

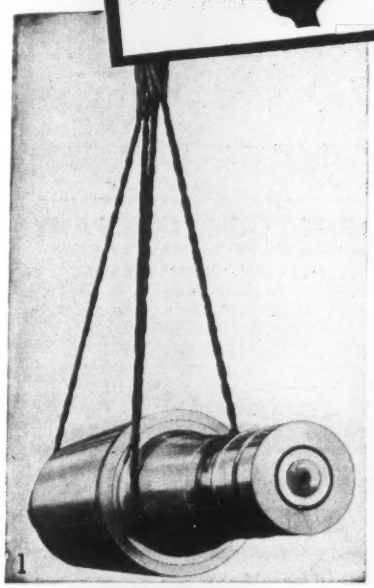
HEAVY... like a turbine cover?

HIGHLY FINISHED... like a paper mill roll?

IRREGULAR... like a casting?

FRAGILE... like a crate of plate glass?

See Answer Below



1

2

1 Handling big steel mill roll without harming smooth finish.

2 Turbine cover is kept level and exactly fitted in place.

3 Sling grips glass crate by edges; no hooks, no damage.

3

The answer to handling *any* "problem" load more easily is a Yellow Strand Wire Rope Plaited Safety Sling.* Flexible, light-weight and kink-proof, this patented type will hoist a locomotive or a barrel with equal security. Each sling has the *stamina* of Yellow Strand Wire Rope. Braided by our expert splicers, its exceptional *pliability* enables it to grip a load softly, snugly and without damage to a delicate surface.

By adding hooks, thimbles, links, shackles, turnbuckles or other fittings, standard Yellow Strand Plaited Safety Slings* are adaptable to products of varied size and shape. If you need a special sling for your special problem, our engineers will design one promptly. For more efficient, more *economical* handling of materials, investigate Yellow Strand Plaited Safety Slings.*

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You'll use this practical wire rope information often. 96 handy pages of facts, tables, illustrations. Send for your free copy *today!*

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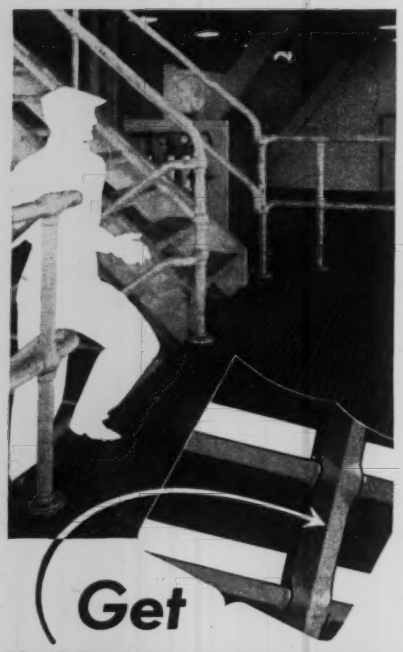
Wire Rope PLAITED SAFETY SLINGS*

* MURRAY PATENTS: U. S., 1475859, 1524671; CANADIAN, 252874, 258068



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FOR YOUR OPEN STEEL FLOORING AND YOUR FLOORS, TOO, WILL BE CLEANER AND SAFER

See that scraper tread—and the crisp lines of the Hex cross bar? *That* gives a safer and cleaner tread and at the bottom of those cross bars you find clean, well-shaped fillets made by the metal displaced in the Bates patented process—no metal is lost. The weld is cleaner and stronger. The *floor* is cleaner and stronger. Yet, open steel flooring made under Bates patents costs no more.

Write for 8½ x 11 booklet that explains all details and shows many fine installations.

WALTER BATES COMPANY, INC.
208 S. LA SALLE STREET • CHICAGO, ILLINOIS
OPEN STEEL FLOORING • STAIR TREADS

superintendent and resident manager of the Maumelle ordnance works project at Little Rock, Ark.

J. Francis Gill, for 19 years commissioner of public works at Oswego, N. Y., resigned his post recently to become general superintendent of the Salina Construction Co. of Syracuse, N. Y. He is succeeded at Oswego by **Robert J. McGann.**

C. O. P. Klotz is now employed as resident engineer with the Aluminum Co. of Canada Ltd., at Kingston, Ont.

Aimé Cousineau, sanitary engineer of the department of health of the city of Montreal, has been appointed assistant director of the department in addition to his other duties.

A. H. Buehman of Lynn, Mass., has been appointed to the engineering staff of the General Electric Co. at Portland, Ore.

Lt. Col. Bruce D. Rindlaub, army district engineer at Tulsa, Okla., for the past year, has been assigned to undisclosed duties, and is succeeded at Tulsa by **Col. Francis J. Wilson.**

Ray E. Lawrence, major, Corps of Engineers, has been promoted to the rank of lieutenant colonel. Colonel Lawrence continues in his present assignment in the engineering branch of the construction division of the Office of the Chief of Engineers. Previous to entering military service, Colonel Lawrence had been first assistant sanitary engineer of the Public Health Department of Kansas, professor of sanitary engineering at the University of Kansas, and later still was associated with the Kansas City consulting engineering firm of Black & Veatch.

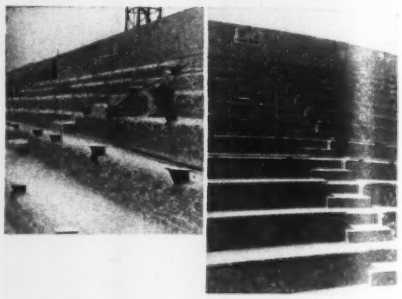
John F. Tribble, who has been serving as chief civil engineer on construction of an airport in Alabama, has returned to the Alabama state highway department from which he had a leave of absence.

The Alameda, Cal., city council, has named City Engineer **George E. Sperbeck** as acting city manager to serve until a permanent appointment is made.

Perry E. Notter, former city building inspector at Wilmington, N. C., has enlisted in the U. S. Naval Reserve for overseas duty with the rank of chief petty officer.

V. Gilmore Iden has resigned as secretary of the American Institute of Steel Construction, after serving the organization since 1928. Mr. Iden has accepted the position of industrial editor of the Bureau of National Affairs, 2201 M St. N.W., Washington, D. C. Mr. Iden, a

"GUNITE" STADIUM



This stadium, at the Sharon, Pa., High School, is a poured concrete structure, that in a few years after completion became so disintegrated as to endanger its safety. The left photo shows all disintegrated concrete removed, cleaned, and reinforcement in place. At right is the completed better-than-new restoration, effected with "GUNITE."

Architects, engineers and contractors are invited to write for our Bulletin 2200, which describes this job, as well as scores of others of varying kinds.

The "CEMENT GUN" can be bought by anyone, and used without restrictions.

CEMENT GUN COMPANY
Manufacturers of the "CEMENT GUN"
ALLENTOWN, PENNSYLVANIA

WE ARE ALSO "GUNITE" CONTRACTORS LET US BID ON YOUR WORK

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FROM sail boat to battleship you will find Electroline-Fiege Wire Rope Connectors wherever positive, permanent wire rope connections are vital. They are first choice wherever wire rope is used.

They are simple, streamlined and strong, easy to install and make a connection that cannot fail. Made in many types and sizes to fill your needs exactly.

If increased wire rope life interests you, you will write today for complete descriptive literature and see for yourself the better features that make this connector a favorite wherever wire rope is used.

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Electroline FIEGE CONNECTORS

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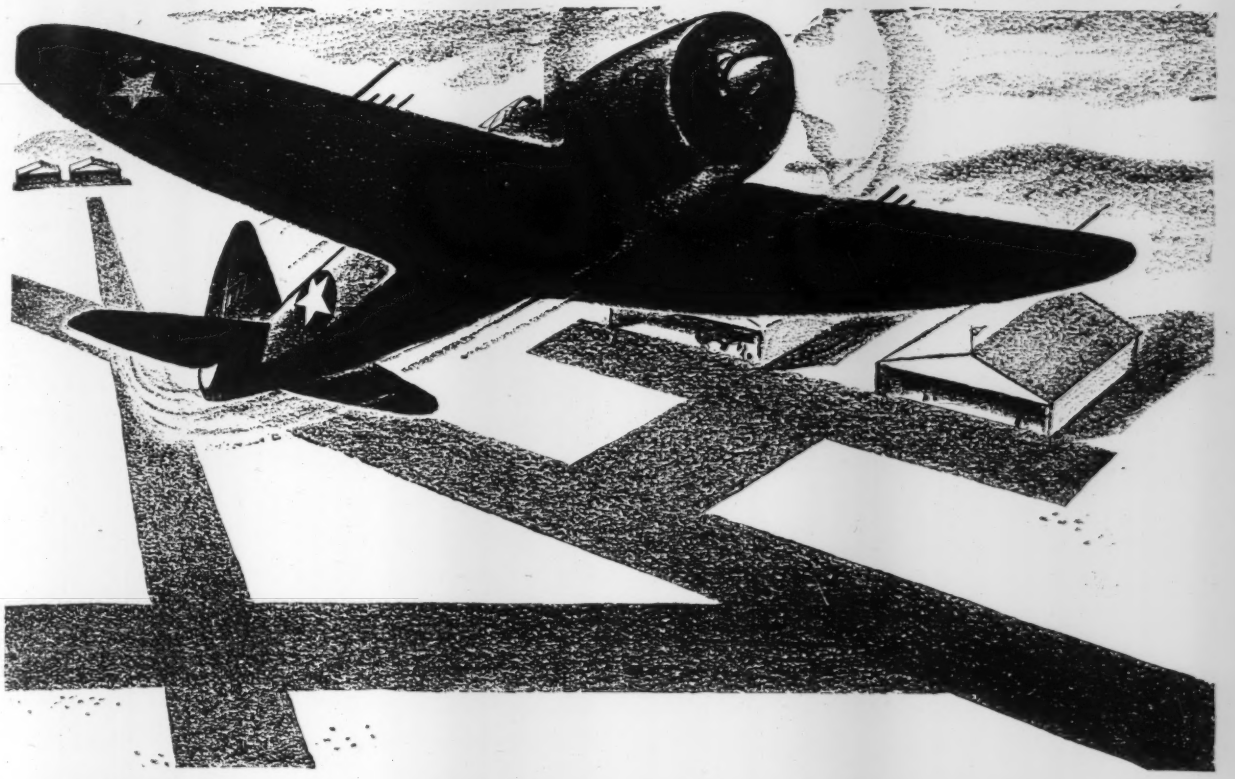

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FOR more than 35 years, Barrett engineers have been working—experimenting—accumulating information on all phases of pavement engineering. Their experience has embraced not only road-building but also the building of scores of civilian and military airports.

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Barrett Tarvia* airport runways, aprons and approach roads are smooth, resilient, frost-proof and non-skid—safe in any weather. They are easy and *quick* to build, and require a minimum of maintenance.

The Tarvia field man will be glad to discuss details with you. Phone, wire or write our nearest office. Perhaps he can show you how to save vital hours in construction time.

Tarvia Base Stabilization

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Barrett Tarvia*

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In Canada: THE BARRETT COMPANY, LTD., Montreal, Toronto, Winnipeg, Vancouver.

On airport runway, industrial plant, defense housing, pier, dock, dam, tunnel, bridge and other War Construction MALL Gasoline Powered Vibrators are daily placing large volumes of low-water-cement-ratio concrete faster and better with less power, less fuel, less water, sand and cement.

MALL vibrated concrete is stronger and better. It has greater water tightness. It is free from honeycombs and voids, thus eliminating expensive hand patching. It assures a firmer bond with reinforcement and permits an earlier stripping of forms.

MALL 1½ H. P.
Gasoline-Powered VIBRATOR

MALL 1½ H.P. Gasoline-Powered Vibrators can be operated anywhere without a generator or compressor set and are easily carried by one man. The variable speed gasoline engine starts easily in cold weather, runs by itself, and supplies ample power for the 8 quickly interchangeable attachments for Concrete Vibrating, Concrete Surfacing, Form Sanding, Wire Brushing, Sharpening tools, Drilling, Sawing with circular saw and Pumping.

Other gasoline engine, air and electrically driven units 1½ H.P. to 3 H.P. are available for Victory Construction. Full details upon request.

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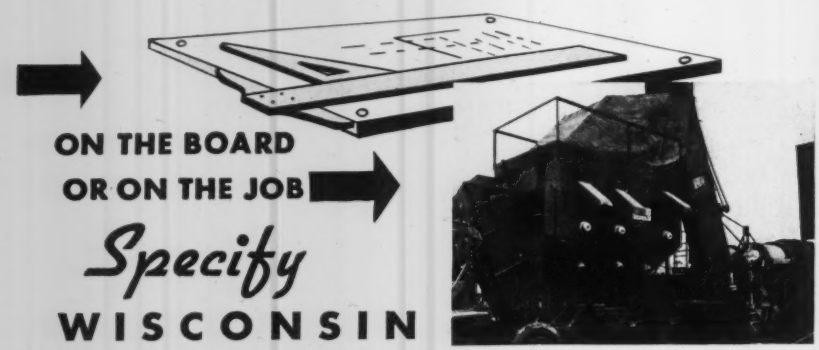

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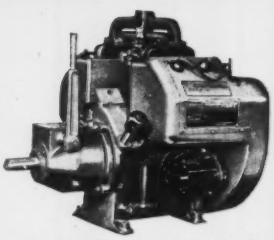
Specify
WISCONSIN
Air-Cooled **ENGINES**

In the development of new equipment, as well as in the efficient utilization of existing machines . . . the power factor is more important today than ever before. That's why Wisconsin Heavy-Duty Air-Cooled Engines rate Number One Consideration.



Model VE-4, 22 hp., 4 cyl., V-type Engines. Other types and sizes, 1 and 4 cyl., 1 to 35 hp.

MOST POWER Per POUND

WISCONSIN MOTOR
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World's Largest Builders of Heavy-Duty Air-Cooled Engines

former managing editor of the *New York Journal of Commerce*, and a well known writer on business and industrial affairs, first entered the service of the A.I.S.C. when he took over public relations work for that organization in 1928.

H. C. Phillips, erection engineer for the Newport News Shipbuilding & Drydock Co., has been assigned to Grand Coulee Dam, Wash., to supervise installation of three turbines in the dam's west powerhouse.

McCutcheon Powell, a contractor of Whitefish Bay, Wis., has been commissioned a lieutenant, senior grade, in the Navy's Civil Engineer Corps, and assigned to Norfolk, Va.

Lieut. X. F. Censullo, USNR, field construction engineer on a marine base in North Carolina, has been transferred to Louisville, Ky., as officer in charge on a construction project there.

Henry F. Alexander, head of the municipal engineering department of Lorain, Ohio, for the past 12 years, resigned Dec. 31. He became city engineer in 1930.

Raymond LeBel, formerly of the consulting engineering firm of J. M. E. Guat, Inc., Montreal, has been commissioned a second lieutenant in the Royal Canadian Engineers.

Morgan Johnson, a civil engineering graduate of Iowa State College, has become an instructor in theoretical and applied mechanics at the school.

Rene Dupuy, civil engineer who was formerly inspector in charge at the Canadian Vickers Ltd., Montreal, is now a member of the British Air Commission, stationed at the Canadian Car & Foundry factory in Ontario.

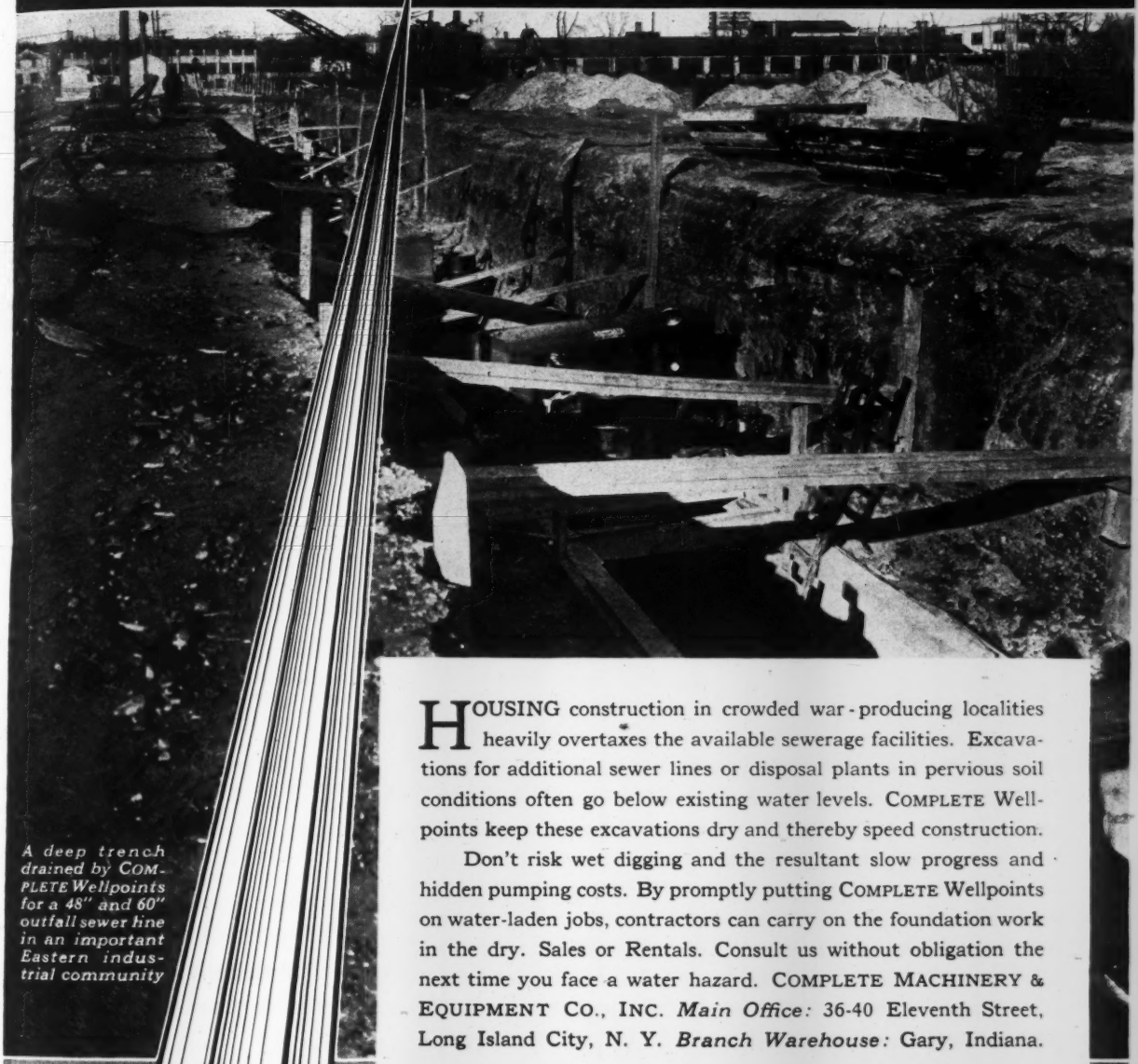
William R. Jacobsen, formerly assistant engineer of the Denver & Rio Grande Western R.R. at Alamosa, Colo., is now stationed at Camp Clairborne, La., as a lieutenant in the Corps of Engineers.

Harold T. Kummen, formerly an engineer with the Aluminum Co. of Canada at Arvida, Que., has become a probationary sub-lieutenant in the Canadian Navy.

L. Cedric Macabee has been appointed town engineer for Los Gatos, Calif.

Charles H. Synyard, of Rochester, N. Y., has been appointed chief engineer of utilities for the William S. Lozier Corp., consulting engineers, for an ordnance depot in upstate New York. Mr. Synyard, who has been with the Lozier organization for the past two years, was formerly employed in the Monroe County, N. Y., engi-

Efficient DE-WATERING SPEEDS WAR HOUSING



A deep trench drained by COMPLETE Wellpoints for a 48" and 60" outfall sewer line in an important Eastern industrial community

HOUSING construction in crowded war-producing localities heavily overtaxes the available sewerage facilities. Excavations for additional sewer lines or disposal plants in pervious soil conditions often go below existing water levels. COMPLETE Wellpoints keep these excavations dry and thereby speed construction.

Don't risk wet digging and the resultant slow progress and hidden pumping costs. By promptly putting COMPLETE Wellpoints on water-laden jobs, contractors can carry on the foundation work in the dry. Sales or Rentals. Consult us without obligation the next time you face a water hazard. COMPLETE MACHINERY & EQUIPMENT CO., INC. *Main Office:* 36-40 Eleventh Street, Long Island City, N. Y. *Branch Warehouse:* Gary, Indiana.

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Shaping a Better World
These capable workers behind the goggles and helmets know exactly what they're doing. More than just shaping a thing of steel, they are helping to fabricate a world that is fit to live in.
Above: Cutting and welding forecastle of Navy Craft
MISSISSIPPI VALLEY
STRUCTURAL STEEL CO.
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NEED A BIG Trailer?
La Crosse Makes Them Up To 200 Ton Capacity-
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All types and capacities for all conditions. Send for Catalog.
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neer department and as designing engineer with the Genesee State Park Commission.

F. Henry Dornemann, formerly associate structural engineer, special engineering division, Panama Canal, has become associate structural engineer, construction plant division for the Tennessee Valley Authority at Knoxville, Tenn.

A. V. Blankenship, of Charlotte, N. C., has been commissioned a lieutenant in the naval civil engineer corps.

Capt. H. Gordon Donald, formerly supervisor of the St. Louis shipyards for the U. S. Navy, has become navy supervisor of the Tampa Shipbuilding Co., at Tampa, Fla.

Maj. A. P. Boutilier, formerly an engineer for the Dominion Steel & Coal Corp. at Sydney, N. S., has become chief works officer with the Canadian Department of National Defense at Sydney.

Robert Francis Seedlock, of the Corps of Engineers, has been promoted to the rank of lieutenant colonel. He is now on duty with an engineer regiment at Camp Claibourne, La.

Lt. Col. Wilson G. Saville, formerly acting district engineer at Galveston, Tex., has been appointed district engineer there, succeeding **Col. L. H. Hewitt,** who left Dec. 4 for other duties.

Martin Moran, chief roads superintendent for the city of Vancouver, B. C., has retired after 34 years of service to the city.

R. G. MacKenzie, assistant in the engineering department of the city of Vancouver, B. C., has been named superintendent of roads, and **Neil MacCallum,** testing engineer, becomes superintendent of the pavement and bridge section for the city.

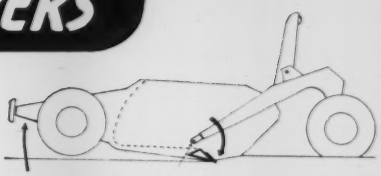
Canada city sponsors housing project

The city council of St. John, N. B., is sponsoring three housing projects with the twofold objective of improving the city's housing situation and permitting the demolition of many old buildings that have been condemned as unsafe or unsanitary.

Construction of the first housing projects for the city is now under way, involving 62 homes, all to be built of brick. In addition to the brick settlement, the city has arranged to build two other colonies of wooden houses, in different sections of the city, to provide a total of about 135 homes in all.

One of 4 Heil 16-yd. scrapers on 200-acre airport project in the Southeast. Over half a million yards of dirt to be moved—fast!

Here's why HEIL CABLE SCRAPERS Bite Deep in hard packed soil



Draft pivot throws scraper weight on cutting bit . . .

The draft pivot point on the side of the bowl is above and *behind* the blade. A pull on the draft hitch therefore causes the bowl to tip up (see arrow at rear). The weight of the scraper then thrusts the blade *deep down* into the cut.

..and pick up these heaping bonus loads easier, faster

Heil owners know what it means to save the time, expense, and trouble of scarifying hard, compact earth. They get real soil penetration and fast loading under tough conditions — tougher than you may believe possible, unless you have seen the latest Heil machines at work . . . This is just one example of the many features developed by Heil engineers to give you faster, more efficient performance under widely varying field conditions — and easier maintenance, longer life, simpler field repairs far from supply bases . . . Heil design gives you all-welded construction, fulcrum-type lift, ample tire clearance — feature after feature that add up to performance that helps you build a reputation as a successful operator . . . Use Heil dirt-moving equipment for faster, easier operation; bigger "bonus loads," and long life performance. . . . Write for bulletins giving details of Heil's advanced design.

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HEIL ANSWERS UNCLE SAM'S CALL

. . . and helps the Arsenal of Democracy supply materials for Victory!

MENT COMMUNIQUE

THE SITUATION IS WELL IN HAND.

When it becomes necessary to shut off valves—in emergencies or otherwise—the situation is well in hand, if the valves are Ludlows!

Operating on the famous double-disc, parallel seat principle, developed and perfected by Ludlow, these dependable valves close securely every time—even after years in the open position. Perfect contact with the valve seats is assured, tension being distributed evenly over the entire area of each gate disc. Smoothness of operation prevents wear—one of the many reasons why batteries of rugged Ludlow Valves—some installed years ago—are meeting the severe demands imposed by today's abnormal service. In peace or war, *Ludlow means value in valves.* Write for Catalog.

THE LUDLOW VALVE MFG. CO., INC.

TROY, NEW YORK

Construction Features: Self-releasing 30° angle wedges and free-floating gates, self-adjusting to seats, afford smooth, trouble-free performance, long service. Rings are cleaned throughout stroke action. Gates are wedge-locked directly opposite ports and completely unwedged before raising. Ample tolerances provide easy action. Simple construction permits easy replacement of parts.

LUDLOW VALVES

SINCE 1866

MEETINGS

AMERICAN SOCIETY FOR TESTING MATERIALS, spring meeting, Hotel Statler, Buffalo, N. Y., week of March 1.

CANADIAN CONSTRUCTION ASSOCIATION, 25th annual convention. Import meeting. Seignory Club, near Montreal, Jan. 20-22.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, Society headquarters, New York, N. Y., Jan. 20-22, 1943.

AMERICAN CONCRETE INSTITUTE, 39th annual convention, Palmer House, Chicago, Ill., Feb. 17-18.

REGIONAL AND LOCAL MEETINGS

ASSOCIATED GENERAL CONTRACTORS OF MISSOURI, annual meeting, joint meeting with HIGHWAY ENGINEERS' ASSOCIATION OF MISSOURI, President Hotel, Kansas City, Mo., Jan. 19-20.

SOUTHWESTERN LUMBERMAN'S ASSOCIATION, "Victory Merchandising Clinic," Des Moines, Iowa, Feb. 4-5.

CONSTRUCTORS ASSOCIATION OF WESTERN PENNSYLVANIA, 9th annual meeting and dinner, William Penn Hotel, Pittsburgh, Pa., Feb. 4.

MICHIGAN HIGHWAY ENGINEERING CONFERENCE, annual meeting, Michigan Union, Ann Arbor, Mich., Feb. 10-12.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Highway Problems Conference, Hotel Pennsylvania, New York, N. Y., Feb. 17-19, 1943.

UNIVERSITY OF UTAH, 4TH ANNUAL HIGHWAY CONFERENCE, Salt Lake City, March 1-2.

Elections and Activities

A. TURNER MCDONALD, engineer for Fulton County, Ga., has been elected president of the Georgia Section of the American Society of Civil Engineers. Other section officers are: Paul Weir, assistant manager of the Atlanta waterworks, vice-president, and M. T. Thompson, district engineer with the U. S. Geological Survey, secretary-treasurer.

THE ANNUAL Michigan Highway Engineer Conference will be held in the Michigan Union, Ann Arbor, Feb. 10-12. Programs are being prepared by a committee under the chairmanship of Roger L. Morrison, professor of highway engi-

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"To Economize— Galvanize at Enterprise!"

18,000 MONOTUBES

Driven for Large Midwestern Steel Plant

A LARGE midwestern steel company recently used 18,000 tapered Monotubes in the construction of three new projects.

In Chicago, Monotubes were chosen because of their extra strength and rigidity. Driving had to be done through a clay formation to sand and gravel, much of it in ground filled with "skulls"—and that requires piles that can "take it"!

In Youngstown, Monotubes were considered best because of a confined and congested working area. Only piles that could be easily and swiftly handled with light, mobile driving equipment would suffice—and that's one of the chief qualities of Monotubes.

In Cleveland, Monotubes were used because of unforeseen ground conditions where length variations ran as high as 100%—requiring flexibility as well as structural strength.

The experience of the engineers and contractors on these three jobs proves the Monotube features of (1) fast handling; (2) fast driving; (3) fast extension; and (4) ease of inspection.

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Cleveland . . United Engineers & Constructors, Phila.; also the owner's own engineering department.
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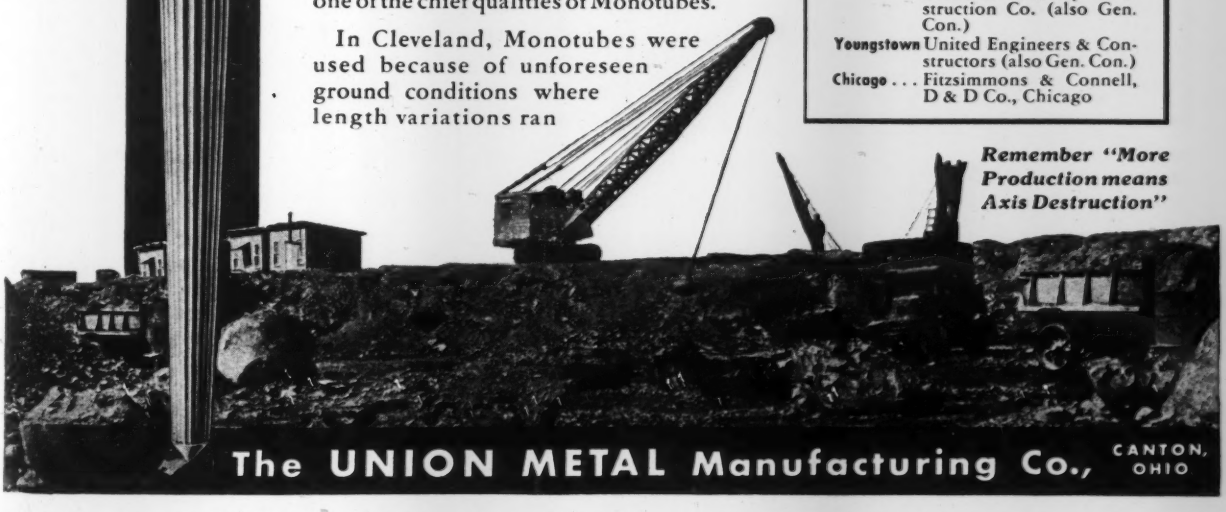
Cleveland . . United Engineers & Constructors (also Gen. Con.) Hunkin-Conkey Construction Co. (also Gen. Con.)
Youngstown United Engineers & Constructors (also Gen. Con.)
Chicago . . . Fitzsimmons & Connell, D & D Co., Chicago



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The UNION METAL Manufacturing Co., CANTON, OHIO

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OUR ARMY'S FAMED HIGH POWER RIFLE

Well built, accurate and exceptionally hard hitting! These are the outstanding and highly praised features of the Garand rifle. Used by both Army and Marine troops, these rifles have won great distinction on the field of action.

Hundreds of thousands of Garands have been made in an amazingly short period of time. But for the raw material producers and the factories—and for the men who built them, there had to be an abundance of water. To the Layne Organization fell the task of producing an amazingly high percentage of that water. The quality and dependability of Layne Wells and Pumps had long been proven on the field of action.

Layne Wells and Pumps are backed by more than sixty years of outstanding success in all parts of the world—and even under the most adverse conditions, they constantly maintained their enviable record of highest efficiency and long life. Layne's activity is now nearly 100 percent for the war effort, but when peace returns, installations for municipal and private industries will be resumed. In the meantime, every effort is being made to supply parts and repair service to all existing installations.

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WORLD'S LARGEST WATER DEVELOPERS

NEERING and highway transport at the state university.

G. NORRIS EVANS has been elected president of the Architectural Institute of British Columbia, succeeding H. Blackadder. E. B. McMaster continues as executive secretary.

NEW OFFICERS of the Carolinas Branch of the Associated General Contractors of America, Inc., elected at a recent meeting are: President, Collier Cobb, Jr., Chapel Hill; vice-president, C. P. Street, Charlotte, N. C.; treasurer, T. M. Sewell, Charlotte; directors, Edwin L. Jones, Robert H. Pinnix, C. Y. Thomason, E. W. Grannis, W. T. Adams, and Ben H. Martin.

LIFE memberships in the American Society of Civil Engineers were presented recently to three Philadelphians at a dinner of the Philadelphia section of the Society. Memberships were given to Wallace E. Belcher, a structural designer, Constructors, Inc.; Charles W. Palmer, associated with the United Engineers & formerly a city engineer specializing in water supply and subway construction, and Samuel H. Rippey, specialist in hydro-electric power development.

HENRY L. HOWE, city engineer and deputy commissioner of public works at Rochester, N. Y., was guest speaker recently at a joint meeting of the Louisiana Engineering Society and the New Orleans Chapter, American Public Works Association. Mr. Howe spoke on "Public Works and Post War Planning."

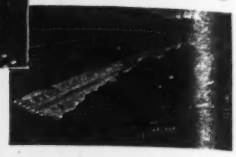
R. V. TILLEY, Sangamon county superintendent of highways, and Colby Beekman, Menard county superintendent, were in charge of arrangements for the annual meeting of the Illinois County Highway Superintendents Association held recently at Springfield, Ohio. Harold D. Hyson of Kankakee, president of the group, presided.

RALPH U. FITTING, JR., was elected president of the Permian Basin Engineers Association at its fall meeting held recently at Midland, Tex. Dewey Jordan was elected vice president; Harold E. Berg, secretary-treasurer; and W. L. Crothers, program chairman.

IGOR SIKORSKY, aviation expert, was principal speaker at a recent meeting of the Cleveland, Ohio, Engineering Society.

W. O. MCCORD, JR., was elected president of the Engineers Club of Chattanooga, Tenn., at a recent annual meeting. Other officers elected were: O. F. Reynolds, first vice president; James M. Alexander, second vice president; A. N.

KEEP YOUR CONVEYOR BELTS GOING



FLEXCO H D RIP PLATES are used in repairing rips and patching conveyor belts. Their use saves expensive replacements and extended shutdowns.

FLEXCO H D BELT FASTENERS make a strong, tight butt joint with long life. Recessed plates embed in belt, compress belt ends and prevent ply separation. Six sizes in steel and alloys.

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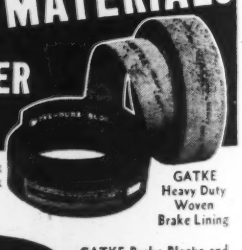

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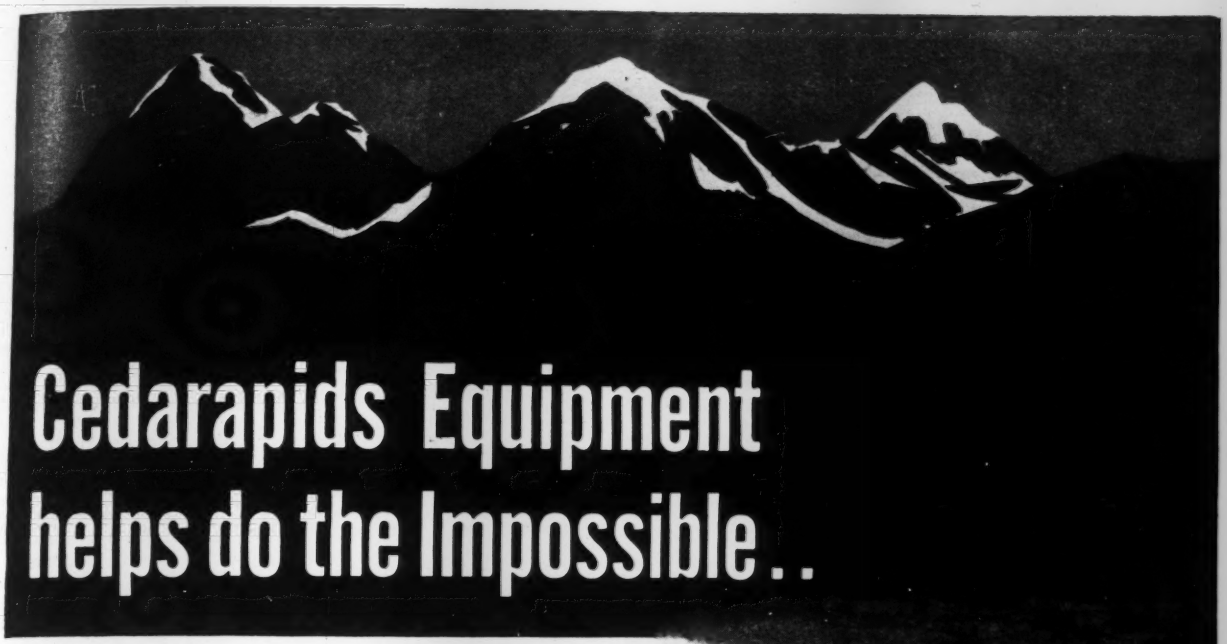

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Investigate the superior feeding, crushing, screening, truckloading and portability features of Cedarapids Tandem Plants. Models to meet all conditions. Also write for complete information about other Cedarapids equipment for stone-crushing, material handling, and asphalt-mixing.

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Master Tandem portable crushing plant for gravel or rock. Big capacity. Low-cost operation. Drives without chains or sprockets.

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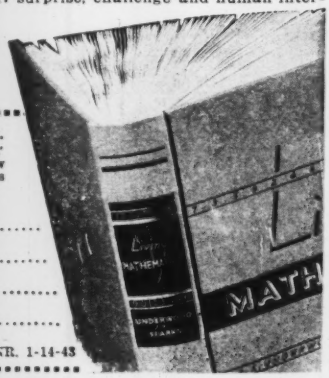

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Doxsey, secretary, and Paul Curtis, treasurer.

THE OREGON building congress has elected the following directors: Harry T. Capell, H. R. Kibler, Fred Manash, A. M. McLean, H. E. Plummer, Victor Shorer, and Glen Stanton.

OFFICERS of the New York State Highway Chapter, Inc., elected at a recent annual meeting, are: F. J. Mulvaney, Binghamton, president; William H. Peckham, White Plains, vice-president; C. W. Maxwell, Albany, secretary-treasurer; Henry L. Deming, Albany, managing director, and Eugene J. Steiner, Albany, attorney. Directors are: Oscar Anderson, Wantagh; A. L. Blades, Hornell; Elis DeLia, New Hartford; Harry Hill, Binghamton; Peter J. Knickenberg, Buffalo; Pierce Law, Herkimer; Leonard Liberto, Union Springs; C. D. Murray, Syracuse; John M. Phillips, Pavilion, and Stanley Di Stefano, Green Island.

NOMINATED at a recent business meeting for high offices in the Associated General Contractors of America, Intermountain Branch, were: Pat Gibbons and Chester Peterson, both of Salt Lake City, Utah, for president; and nominations for other offices were also made. Those nominated were: Clarence Waterfalls of Ogden, and Ted Jacobsen of Salt Lake City, Vice-President; J. H. Tempest and H. Schraven, Salt Lake City, secretary-treasurer; J. W. Grant of Springville, Meade Garff, E. W. Barber and Frank Fullmer of Salt Lake City, directors. The annual meeting will be held on January 22 and 23 at the Hotel Utah, when election of the new officers will be held.

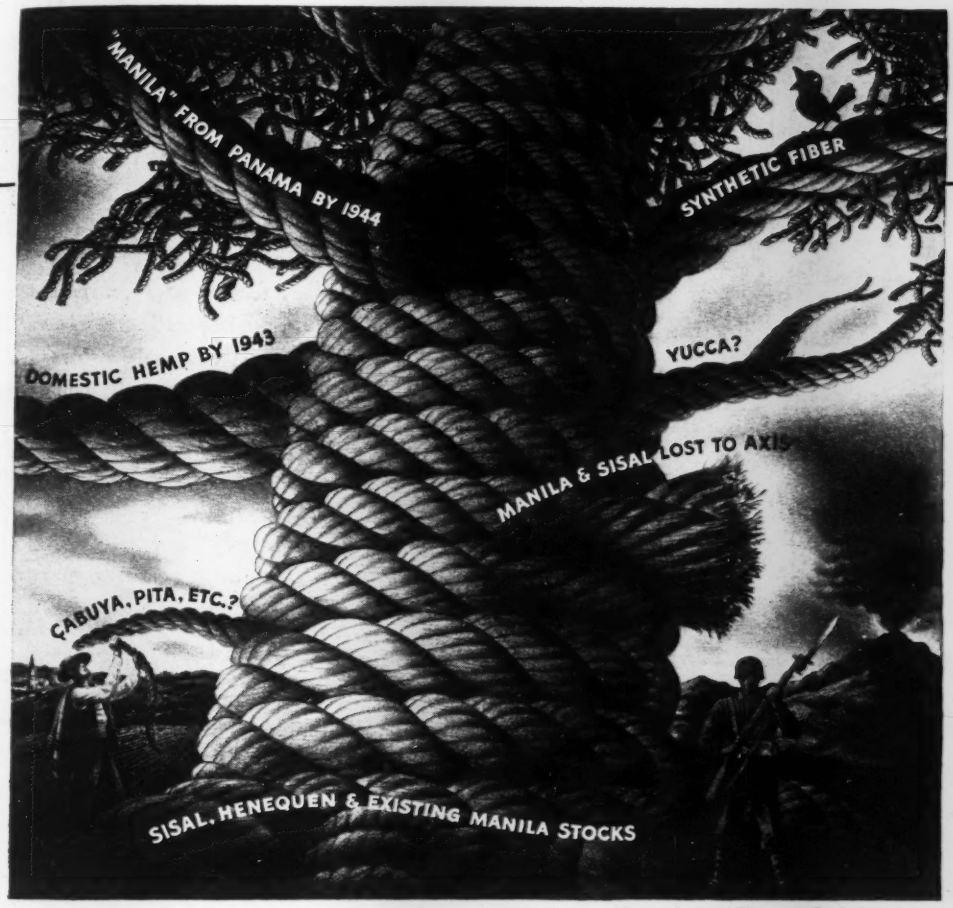
AT A MEETING of the Cheyenne, Wyo. Engineers Club held recently, the following officers were elected for the coming year: Kirby H. Olds, president; Archie Allison, vice-president, and John F. Lo Sasso, secretary-treasurer.

WALTER L. BULIE, of Montreal, has been elected president of the Association of Forestry Engineers of the Province of Quebec.

HARRY L. MCFEATERS, chief engineer of the Pennsylvania Engineering Co., of New Castle, Pa., has been elected president of the Mahoning-Shenango Valley Engineers Society. Others elected are: Paul G. Dingledy, vice-president; Lester L. Weitzel, secretary; Sid L. Lockley, treasurer, and Frank J. Bowers, Youngstown, and Thomas Baum, New Castle, council members.

JOHN L. HARVEY, Albany superintendent of power control of the New York Power & Light Corp., was elected president of the Albany, N. Y., Society of Engineers at an annual meeting recently.

WATCH THE BIRDIE!



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Some day, that birdie will be singing a sweet song for American engineers.

. . . You can depend upon Plymouth to pioneer a way, through experiment with natural fiber, as well as through the development of synthetics, to supply you with the rope you need, as quickly as is humanly possible.

Meantime, save rope, save twine.

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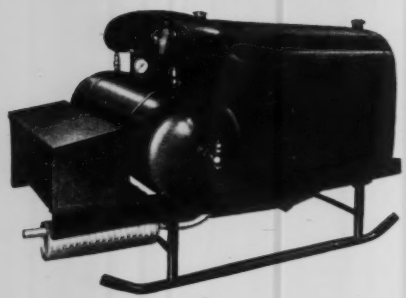
THE *Rope* YOU CAN TRUST

Save time and money with this new VICTORY

MODEL SMITH AIR COMPRESSOR

(less critical material than any other standard compressor)

SMITH AIR COMPRESSORS



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Other officers include: Robert Forster, first vice-president; George A. Powell, second vice-president; Arthur H. Lamborn, third vice-president, Thomas Stickley, librarian, and Stephen C. Bunting, secretary and treasurer.

THE Quebec section of the Canadian Institute of Engineering recently elected Rene Dupuis, director of the electrical engineering school at Laval University, as president.

B. F. MODGLIN, of MacDonald & Kahn, Inc., San Francisco, has been elected president of the Southern California Chapter of the Associated General Contractors of America. Howard G. Huntley, of San Jose, was elected vice-president, and Floyd O. Booe, general manager.

RALPH BARTELSMEYER, of Nashville, has been elected president of the Illinois County Highways Superintendents Association. Other officers elected are William Hauck, of Morrison, vice-president, and Forest Fisher, of Urbana, secretary.

THE STRUCTURAL Engineers Association of Northern California has elected officers for 1943 as follows: President, J. Bertrand Wells; vice-president, M. C. Poulsen; directors, Theo. P. Dresser, Jr., S. S. Gorman, and Mac D. Perkins, Franklin P. Ulrich was re-elected secretary-treasurer.

H. B. FOOTE, of the Montana State Board of Health, has been elected president of the Helena Engineers Society. Fred V. Munro was chosen vice-president, and A. C. Heckenlaible, secretary-treasurer.

THE SEATTLE chapter of the Associated General Contractors has elected Noble White as president; A. L. Atherton, vice-president; George Johnson, secretary, and Don Mowat, treasurer.

VICTOR J. SNYDER was elected president of the Pennsylvania Society of Professional Engineers at a meeting at Harrisburg. Other officers elected are: George A. Rahn, vice president; C. Fred Germeyer, secretary; Edgar A. Weimer, treasurer, and H. Root Palmer and Warren K. Myers, state directors.

HERBERT W. BROWN, Milwaukee water works superintendent, has been elected president of the Wisconsin section of the American Society of Civil Engineers. Other officers are: Arthur L. Boley, Sheboygan, 1st vice president; E. L. Roettiger, Madison, 2nd vice president; O. Neil Olson, Marquette University, Milwaukee, secretary-treasurer; F. M. Sloane, Milwaukee, director. Berry Brevik, of the Portland Cement Association at Milwaukee is the retiring president.

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As more materials are diverted to essential war uses, new equipment becomes more difficult to get. Greater care must be given present equipment until after Victory. Let your Gorman-Rupp distributor restore your equipment to its original operating efficiency. They carry parts and repairs for all equipment they sell. Their charges will be reasonable.

Gorman-Rupp Self-Priming Centrifugal Pumps are available for immediate delivery through Gorman-Rupp Distributors.

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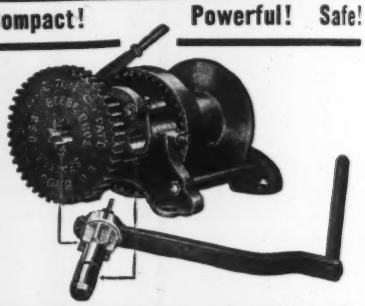
Compact! Powerful! Safe!



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1200' assembled pipe (132 Tons) were lowered to bed of Mississippi at St. Paul with 9—5-Ton Beebes, three lines to each hoist through blocks.

Hudson River Bridge sidewalks were laid in sections with 32—5-Ton Beebes.

Longest wooden trusses in world were installed with ONE 5-Ton Beebe after power hoists proved impractical.

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When raising, lowering, or placing costs by power are a serious problem, the answer is the right number of Beebe Bros. All Steel Hand Hoists MANNED IN UNISON. Available in 2, 5 and 15 Ton sizes. Sold through leading dealers in all trade centers. List of dealers sent upon request.

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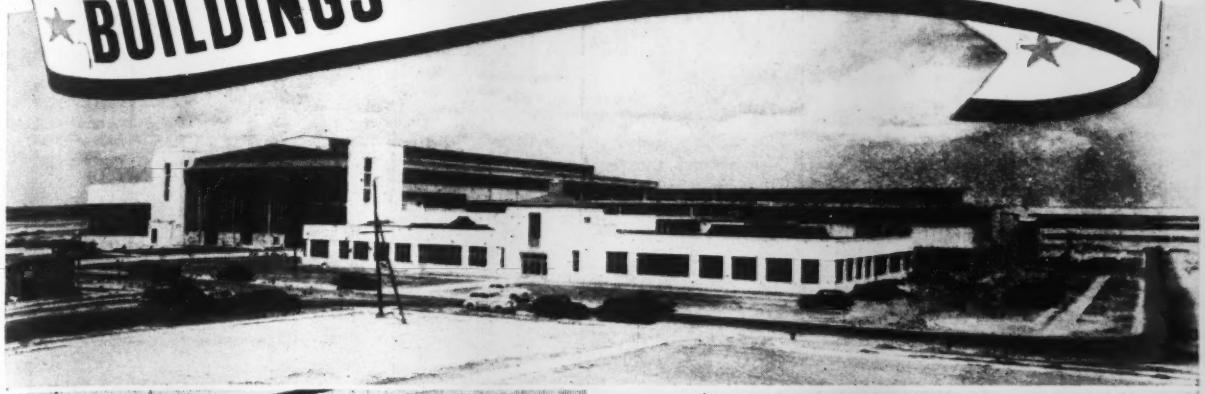

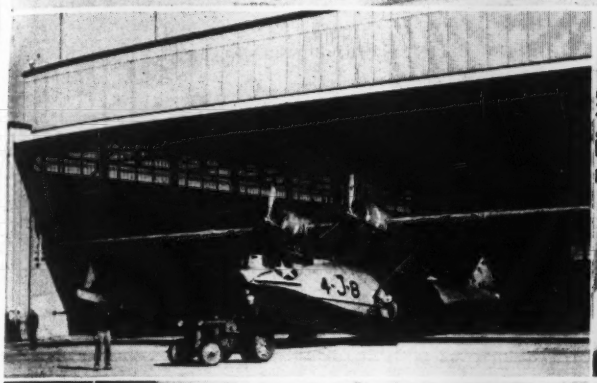

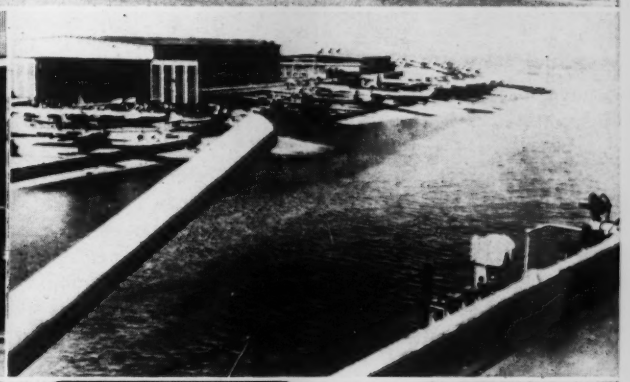

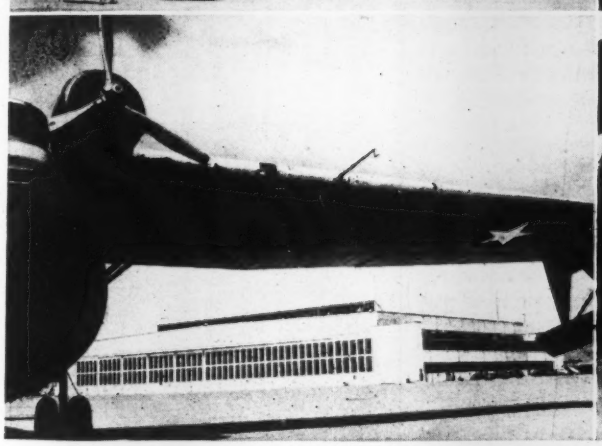

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Many of these air bases rival a small city in size. The amount of hardware required . . . for doors, windows, cabinets . . . is tremendous, and much is being furnished by Stanley.

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These valves assure you of a full line opening without pressure drop and are furnished in either automatic or manually operated designs. Its high quality construction and material assure you of superior service.

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Be positive of low operational cost . . . Specify Golden-Anderson Valves. An established reputation guarantees performance beyond normal expectations. Write for complete and detailed descriptions of all Golden-Anderson Valves today.

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TRENDS IN THE NEWS

Southern Cities Meet Refuse Collection Problems

Labor turnover, difficulty in securing trucks and repair parts, and the increased volume of refuse in a number of cities are the chief problems facing the refuse collection departments of southern cities, according to a recent summary by Carl J. Schneider, consulting engineer, New Orleans division of public works. In the December *News Letter* published by the American Public Works Association he reports the following:

At New Orleans, labor shortages in the division of public works refuse collection crews, have been met to some extent by drawing upon labor from other branches of the division. This temporary solution is supplemented by over-time and Sunday work by regular crews in the refuse collection department. Material and repair part shortages are being met by substitution, by application of priority ratings where justifiable, and in many cases, by "doing without." The increased volume of refuse from Army posts and Naval stations, from ships in port, and from seafood packing plants has created new demands upon the refuse collection services.

• • •

Ordinances prevent "Shacktown" developments

California cities and counties are using two types of ordinances to prevent trailer camps and auto courts from degenerating into "shacktowns," the American Society of Planning Officials reported recently.

The homes-on-wheels, which shelter many war workers and migrant crop pickers, must come up to certain standards in at least 25 cities and eight counties of the state which have adopted the "model" ordinances, prepared by the state division of immigration and housing. Other municipalities have adopted variations of the models.

The model ordinance controlling trailer camps and tent spaces in incorporated cities was first adopted by Banning, in 1936, and now is in force in 25 cities including Santa Ana,

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You've Got to Know the Angles to Keep Shifts Running 'Round the clock and 'Round the Week

HERE THEY ARE...Right Angled Loading for ALL THRUST Bearings

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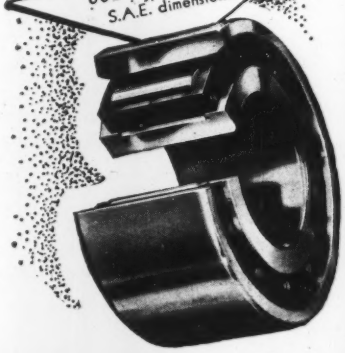
Interchangeable with standard double-width bearings made to S.A.E. dimensions.



Yes Sir, smart production and maintenance men are paying a lot of attention to the Angles these days—especially when it comes to anti-friction bearings. They know you can't expect precision bearings to carry complex loads at high speeds hour after hour, for day on end, without frequent down-time for servicing and replacements. That's why they're demanding the higher service factors provided by Rollway's *right-angled* loading of solid cylindrical roller bearings.

Rollway splits every load into its two simplest components of *pure radial* and *pure thrust*. All oblique and compound loading is eliminated. Sliding friction is reduced to the vanishing point. And a more compact bearing assembly with more massive rollers of uniform cross section is the result. You'll notice improvement in bearing life, speed of operation and amount of down-time and service attention almost immediately.

Free Engineering Analysis and Bearing Recommendations

Let Rollway's bearing specialists examine your plans, especially your conversions, and tell you the right type and series for each bearing. There's no charge for this service. Most applications require only American standard metric dimensions and tolerances. REMEMBER, you can usually change over from other bearings to ROLLWAY'S of higher load capacities without increasing boundary dimensions.

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BUILDING HEAVY-DUTY BEARINGS SINCE 1908 — BEARINGS

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HANDBOOK OF APPLIED HYDRAULICS

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1100 pages, 6 x 9, 645 illustrations, many tables, $7.50

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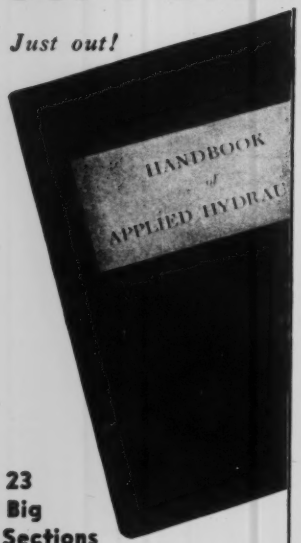

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Marysville and Vallejo. To control unincorporated areas, an ordinance regulating auto and house courts and camp spaces and prohibiting squatter camps has been adopted by eight counties, including Ventura, Santa Barbara and San Luis Obispo just north of Los Angeles.

Features of the city trailer camp ordinance are as follows: The city planning commission—or if there is none, the building or health department—must approve the location of a trailer camp site after public hearings, and the city council grants the application for permit. House trailers must be eight feet apart, and eight feet from any lot line, the grounds kept drained, sanitary and lighted, and water supply from faucets provided. Trailers must not be fixed permanently to the ground. Separate toilet facilities for men and women are specified, one to every 10 tents, camp cars or trailers, along with bathing facilities and hot and cold water. Refuse and sewage disposal facilities must be provided.

The model ordinance for unincorporated areas puts the duty of enforcement on the county health department. Among requirements the ordinance specifies that partitions between cooking and sleeping rooms in any house court building be full length, and that all cooking rooms be equipped with running water. Minimum air space, room size and windows are specified, and no habitation is to be constructed of "sacks, rags, bush cans, weeds or refuse material."

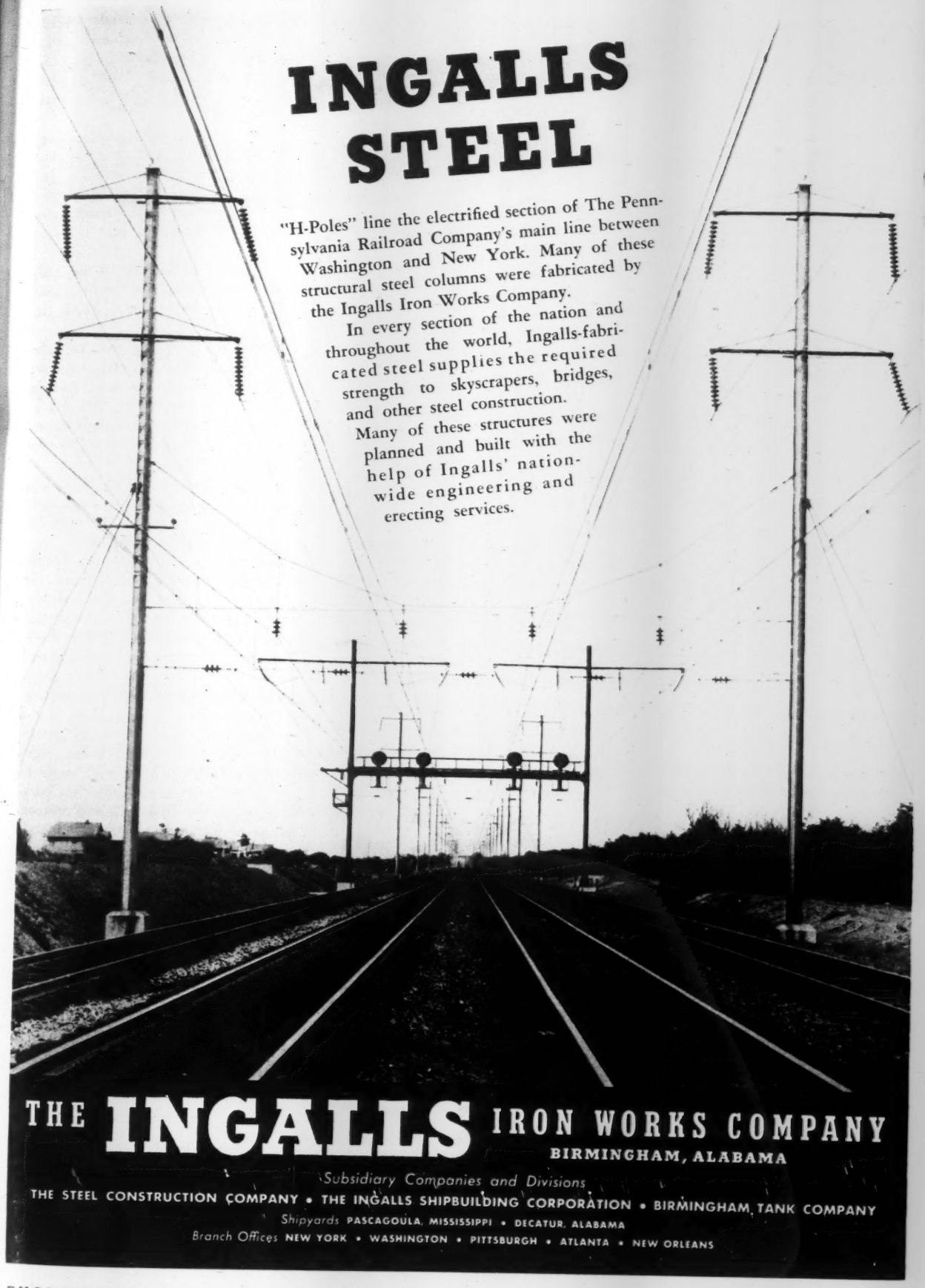
State health and safety code regulations on auto courts and trailer camps in unincorporated areas, and parts of the state housing act applicable to courts and camps in incorporated cities, also have aided in keeping down shacktowns, according to the division of immigation and housing.

• • •

Suggestions for traffic sign improvements

Traffic signs should be standardized and kept clean and in good repair to eliminate confusion of motorists and pedestrians, and to reduce accidents, a report on traffic signals in St. Paul, made for the city's department of public works and safety, recommended recently.

The improvements, which require



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The Amsco Missabe Dipper was an acknowledged advance over any previously built and it is still popular with operators in coal stripping, harbor dredging and in the Iron Range from which it got its name. This dipper's body has a front and back casting securely riveted together through overlapping sections. Bail brackets are on the front casting and are placed at an angle conforming to the line of bail pull so that shearing of rivets and pulling apart of front and back are virtually impossible.

In 1930, Amsco developed the first true renewable lip dipper, with the patented U-bolt fastening, interlocking joint design. This allowed lips to be changed in minutes instead of hours.

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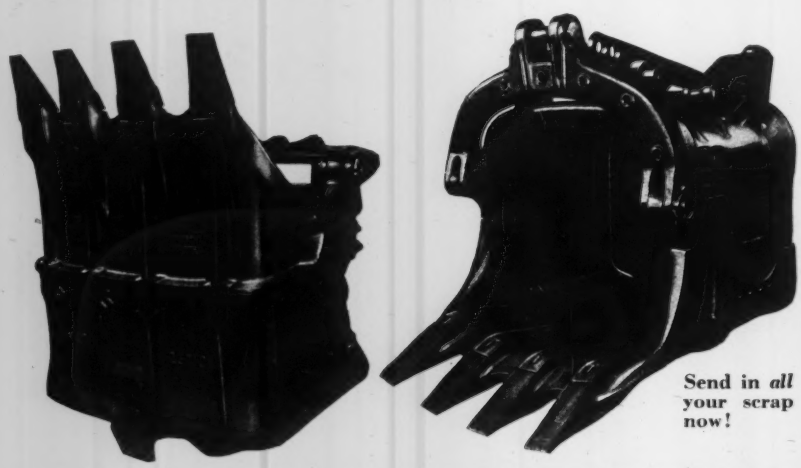

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use of critical war materials, are expected to be carried out as soon as conditions permit, according to the commissioner of public works. They were recommended after a survey showed that:

Nearly a dozen agencies, including five city departments, railroads, bus companies, business associations and the state fair, put up traffic signs or barrier markings with variations in wording of messages and types of signs.

More than 40 per cent of the 5,208 traffic signs were "stop" signs, many of them four-way stops, which frequently were ignored.

Portable advertising and "no parking" signs along curbs—usually placed by service stations, garages and parking lots—were growing in number, and because of their resemblance to traffic signs tended to confuse motorists.

Nearly 50 per cent of all traffic signs were dirty, faded or rusty, bent, loose and broken, while many were obstructed from motorists' view.

In providing for a more effective traffic sign maintenance program, the city was advised to establish a regular department to supervise installation and maintenance of all signs. Washing of traffic signs and cleaning and frequent repainting of barrier markings were recommended as important in maintenance.

Other recommendations of the report were that advertising signs which conflict with traffic signs be removed, use of portable "no parking" signs discontinued, and obstructions to traffic directions eliminated. Pavement markings, especially lanings, should be used more freely, the report also suggested.

A further recommendation was that traffic controls be revaluated where changing conditions, such as gasoline rationing, have affected the traffic situation.

• • •

Plan Pan American Highway link to Carribean Sea

The Public Roads Administration has sent a highway engineer to Colombia to investigate the route from Dabeiba, the northernmost point in South America reached by the Pan American Highway, to the port of Turbo on the Gulf of Uraba in the Caribbean.

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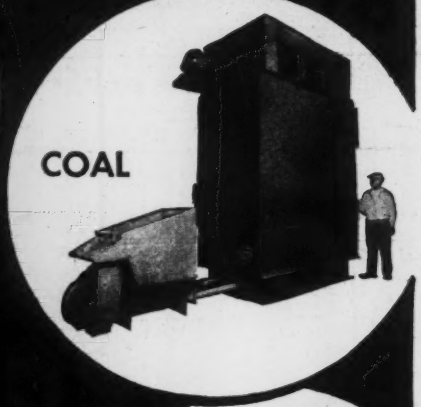

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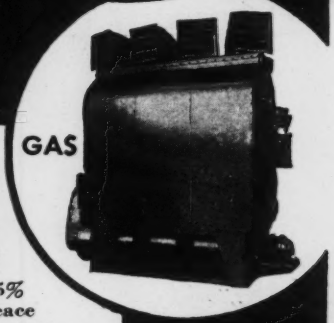

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The distance between Dabeiba and Turbo is about 80 miles. The United States engineer is working in co-operation with engineers of the Colombian Government and the Province of Antioquia, in which Dabeiba and Turbo are located.

After the preliminary survey is completed a credit may be obtained in the United States with which to construct this important 80-mile link in the shortest possible time. Dr. Gabriel Turbay, Colombia's Foreign Minister, is negotiating with the State Department regarding the financing of the new highway.

This road is of the greatest strategic importance, as it will be Colombia's only highway to the Caribbean Sea. When finished, the road will permit direct passage from the Pacific port of Buenaventura to the Caribbean. Turbo is situated on a wide bay capable of handling deep draught vessels.

When this new 80-mile section is completed it will be possible to drive an automobile from the Mexico-Guatemala border over the new pioneer road now under construction in Central America to Panama City and to Colon. This new pioneer road is expected to be open for traffic sometime in June, 1943.

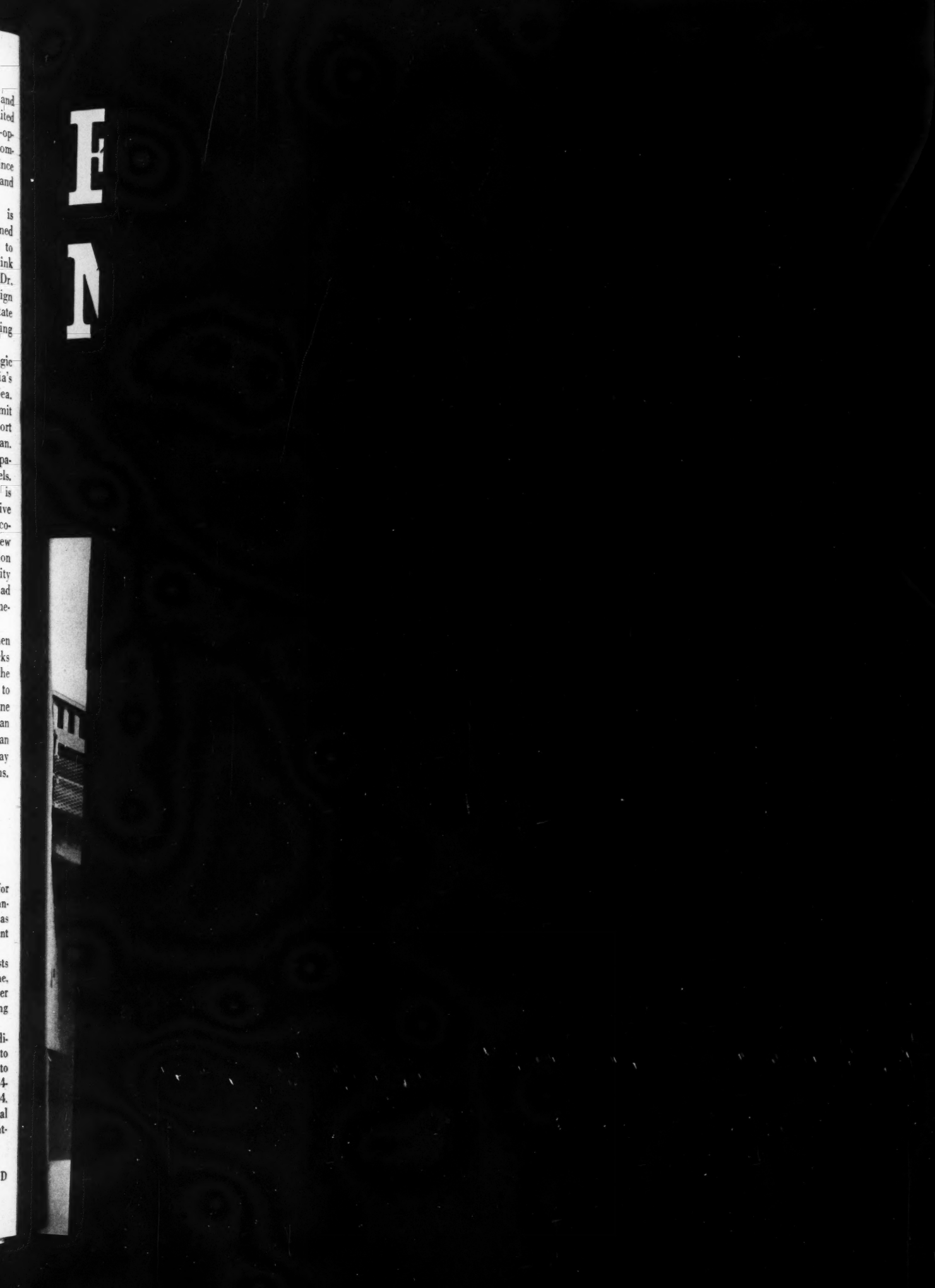
From Colon, a ferry could then transport automobiles and trucks across the Gulf of Darien and the Gulf of Uraba, about 300 miles, to the port of Turbo. From Turbo one will be able to drive over more than 10,000 miles of the South American section of the Pan American Highway System and its principal connections.

• • •

Note increase in highway right-of-way cost

The cost of acquiring right-of-way for the modern highways built by the Pennsylvania Department of Highways has shown a progressive increase in recent years, according to a recent report.

Previous to 1931, the right-of-way costs were borne by counties. Since that time, the department has assumed a larger share with county contributions showing a steady decline.

During the fiscal year 1931-32, expenditures for right-of-way amounted to $3,736.29. By 1933 they increased to $17,196.05. During the fiscal year 1934-35, the figure had mounted to $231,232.04.

Largest figure was shown for the fiscal year just closed, when costs for right-of-way totaled $2,925,636.39.